

Contents

1	Introduction	1
1.1	Biology of the uterus	1
1.1.1	Anatomy and function of the uterus	1
1.1.2	Origin of the contractions	4
1.1.3	Uterine contractility during pregnancy and labour	6
1.2	Risk situations during pregnancy, labour and postpartum	8
1.2.1	Preterm birth. Prevalence in multiple gestation.	8
1.2.2	Prolonged pregnancy and induction of labour	10
1.2.3	Postpartum haemorrhage: vaginal and cesarean delivery	18
1.3	Clinical techniques to monitor pregnancy progress and predict delivery imminence	21
1.3.1	Biochemical markers of inflammation	21
1.3.2	Cervical assessment	22
1.3.3	Uterine dynamics	23
1.4	Electrohysterography	26
1.4.1	Electrohysterographic signal components	27
1.4.2	Electrohysterographic signal analysis	28
1.4.3	Uterine electrophysiological changes	29
2	Justification and objectives	37
2.1	Main objective	38
2.2	Specific objectives	38

3	Overdistention accelerates electrophysiological changes in uterine muscle towards labour in multiple gestations	39
3.1	Introduction	41
3.1.1	Preterm Birth	41
3.1.2	Current Predictive Techniques in Clinical Practice	42
3.2	Materials and methods	43
3.2.1	Study Design	43
3.2.2	Clinical Data	43
3.2.3	EHG Signal Acquisition	44
3.2.4	EHG Signal Analysis	45
3.3	Results	46
3.4	Discussion	49
3.4.1	Changes in multiple gestation	49
3.4.2	Role of uterine distension	52
3.4.3	Limitations and future lines of research	53
3.5	Conclusions	54
4	Uterine Myoelectrical Activity as Biomarker of Successful Induction with Dinoprostone: Influence of Parity	55
4.1	Introduction	56
4.1.1	General overview of induction of labour	56
4.1.2	Risk factors for failed induction of labour	57
4.1.3	The role of electrohysterography in obstetrics	57
4.2	Materials and methods	64
4.2.1	Study design	64
4.2.2	Recording protocol and EHG acquisition	64
4.2.3	EHG parametrisation	65
4.2.4	Statistical analysis	69
4.3	Results	70
4.3.1	Obstetric data and outcomes of labour induction	70

4.3.2	Comparative of the success and failure of the labour induction	72
4.3.3	Comparative of nuliparous and parous uterine myoelectrical activity in labour induction success	73
4.4	Discussion	75
4.4.1	Labour induction success vs. failure	75
4.4.2	Influence of parity on uterine myoelectric response during IOL	76
4.4.3	Limitations of the study	78
4.5	Conclusions	79
5	A Comparative Study of Vaginal Labour and Caesarean Section Postpartum Uterine Myoelectrical Activity	81
5.1	Introduction	83
5.2	Materials and Methods	85
5.2.1	Signal Acquisition	85
5.2.2	Data Analysis	86
5.3	Results	88
5.4	Discussion	89
5.5	Conclusions	93
6	General discussion	95
6.1	Recommendations for the electrohysterographic recording acquisition	95
6.2	Assessment of EHG-biomarkers in high-risk obstetrical scenarios . .	97
6.2.1	Temporal EHG-biomarkers	97
6.2.2	Spectral EHG-biomarkers	98
6.2.3	Non-linear EHG-biomarkers	99
6.2.4	Approaches for electrohysterographic analysis: WEWA and EBA	101
6.3	Overdistension effect on uterine activity in multiple gestation	102
6.4	Electrophysiological uterine activity in response to the induction drug	103
6.5	Postpartum uterine monitoring challenges and the promise of electrohysterography	104
6.6	Current limitations and prospects for future research	106

CONTENTS

7	Conclusions	109
8	Related publications	111
8.1	Comparative Study of Uterine Myoelectrical Response to Labour Induction Drugs in Nulliparous and Parous Women with Different EHG Analysis Techniques	112
8.2	Comparison of the Electrophysiological Myoelectrical Activity Evolution in Induction of Labour with Pharmacological and Mechanical Methods	119
9	Bibliographic references	129
A	Parameters for electrohysterographic signal characterization	173
A.1	Temporal parametrization	173
A.2	Spectral parametrization	174
A.3	Non-linear parametrization	175
B	EHG-biomarkers significance in different high-risk obstetric settings	181
C	Obstetric factors affecting myometrial contractility	183
C.1	Interplay of previous pregnancies with uterine contractility	183
C.2	Influence of maternal age and weight on uterine contractility	184