

Contents

1 Introduction	1
1.1 Historical Review	1
1.2 Statistical Frequency of Major Limb Replantation	2
1.3 Problematical Aspects of Major Limb Replantation and Prosthetic Supplementation	3
2 Pathophysiological Analysis of Ischemia-Induced Injury in Major Limb Replantation	9
2.1 Dermis and Subcutaneous Tissue	9
2.2 Connective Tissue, Bone, and Cartilage	10
2.3 Lymphatic System	11
2.4 Peripheral Nerves	12
2.5 Ischemia-Induced Myopathy and Microangiopathy	14
2.5.1 Anatomical and Physiological Basis of Striated Muscle Perfusion	14
2.5.2 Regulatory Mechanisms of Fiber-type Distribution and Muscle Cell Morphology	16
2.5.3 Muscle Cell Metabolism and Ischemia Tolerance	18
2.5.4 The “No-Reflow Phenomenon”	22
2.5.5 Regeneration Potential of Striated Muscle	27
2.6 Compartment and Postischemia Syndromes	30
2.6.1 Compartment Syndrome	30
2.6.2 Postischemia Syndrome	32
2.6.2.1 Circulatory System and Metabolic Disorders	34
2.6.2.2 Kidney Function	35
2.6.2.3 Coagulation Disorders	37
2.6.2.4 Toxemia and Infection	39
3 Materials and Methods	41
3.1 Product Description	41
3.2 Analytic Methods	42
3.2.1 Storage and Perfusion in Isolated Rat Hind Limbs	42
3.2.2 Analysis of Perfusate	44
3.2.3 Storage and Perfusion in Canine Hind Limbs	44
3.2.4 Determination of Reperfusion Effect	47
3.2.5 Histological and Electron-Optical Analyses	48
3.2.6 Washout Effect and Quantitative Determination of Residua	49
3.2.7 Method of Perfusion	49
3.3 Statistical Methods	50

4 Results	51
4.1 Storage and Reperfusion Attempts	51
4.1.1 Metabolic Studies	51
4.1.2 Experiments with Perfusates	51
4.1.3 Systemic Measurement, Reperfusion Effect	53
4.1.3.1 Determination of pO_2 , pCO_2 , Bicarbonate, and Base Excess	56
4.1.3.2 Washout Effect: Blood Gas Analysis	56
4.1.3.3 Inorganic Phosphate Levels in Serum	56
4.1.3.4 Washout Effect and Descending Curves with ^{125}I -labeled HbPP Solution	58
4.2 Histomorphology and Ultrastructure	58
4.2.1 Electron-Optical Results in Rat Hind-Limb Musculature	58
4.2.2 Photomicroscopical Studies in Canine Models	59
4.2.2.1 Dry-Cooling Group	59
4.2.2.2 HbPP Perfusion Group	62
4.2.2.3 Sham Procedure Group	65
4.2.2.4 Contralateral Extremities	65
4.2.3 Histological Studies of Kidneys and Livers	65
4.2.3.1 Dry-Cooling Group	65
4.2.3.2 HbPP Perfusion Group	66
4.2.3.3 Sham Procedure Group	66
4.2.4 Electron-Optical Studies in Dogs	66
4.2.4.1 Dry-Cooling Group	66
4.2.4.2 HbPP Perfusion Group	71
4.2.4.3 Sham Procedure Group	73
5 Discussion	74
5.1 Major and Minor Limb Replantation	74
5.2 Perfusion, Storage, and Pharmacological Treatment of Postischemia Syndrome	75
5.3 Metabolic Studies	83
5.3.1 Reperfusion Effect	85
5.3.2 Determination of Residua	87
5.4 Histomorphological and Electron-Optical Findings	88
5.5 Conclusions	90
6 Summary	91
7 References	94
8 Subject Index	123