

Neonatal Pain

Suffering, Pain and Risk of Brain Damage in the Fetus and Newborn

Giuseppe Buonocore • Carlo V. Bellieni

Editors

Neonatal Pain

Suffering, Pain and Risk of Brain Damage
in the Fetus and Newborn

Foreword by Ignacio Carrasco de Paula



Giuseppe Buonocore
Department of Pediatrics, Obstetrics and
Reproduction Medicine
University of Siena
Siena, Italy

Carlo V. Bellieni
Department of Pediatrics, Obstetrics and
Reproduction Medicine
University of Siena
Siena, Italy

Cover illustration: Leonardo da Vinci, The Babe in the Womb, c. 1511 (detail).
The Royal Collection © 2007 Her Majesty Queen Elizabeth II

Library of Congress Control Number: 2007938688

ISBN 978-88-470-0731-4 Springer Milan Berlin Heidelberg New York
e-ISBN 978-88-470-0732-1

Springer is a part of Springer Science+Business Media

© Springer-Verlag Italia 2008

springer.com

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the Italian Copyright Law in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the Italian Copyright Law.

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use. Product liability: the publisher cannot guarantee the accuracy of any information about dosage and application contained in this book. In every individual case the user must check such information by consulting the relevant literature.

Cover design: Simona Colombo, Milan, Italy
Typesetting: C & G di Cerri e Galassi, Cremona, Italy
Printing: Arti Grafiche Nidasio, Assago (MI), Italy

Printed in Italy
Springer-Verlag Italia S.r.l. – Via Decembrio 28 – I-20137 Milan

Preface

For many years we have been talking about a very special patient, the embryo; and the numerous and encouraging successes brought about by embryofetal medicine in the application of both noninvasive therapies and invasive ultrasound-guided treatment are well known.

On the other hand, it is more and more often the case today that the small patients in neonatal care are premature babies who have come to the world at a particularly low gestational age. This allows us to observe the continuity between the phases of growth inside the maternal uterus and after birth, which arrives at the correct moment for some lucky fetuses, for others very early, and for some altogether too soon. The neonatologists have the arduous task of sustaining these little patients in their strivings to survive, registering their energy and their vital dynamism, studying the progressive development of the anatomical structures and the improvement of their physiology, verifying day by day the presence – sometimes fragile, sometimes extremely resistant, but always human – of a child.

A long line research has shown how, from the first moment onwards in that process of perfectly coordinated development that characterizes the life of the embryo, a human being gradually emerges who is increasingly able to interact with his or her environment. Despite neurosensory immaturity, some unsuspected perceptive abilities have been found in the fetus, particularly in regard to the perception of pain, which can be also deeper in the following phases of development, that is, in the child once it has been born. However, the large amount of scientific evidence attesting to the fact that the fetus can already feel pain around halfway through the pregnancy have not been welcomed by the international scientific community; in fact, very varying positions are recorded, with inevitable consequences at both the clinical and the ethical level.

The issue of fetal pain is one of the so-called border subjects, which go well over the positive data of the experimental study to involve the minds and consciences of those contemplating it, arousing opposing reactions and discordant opinions. In the political arena too, the issue of fetal pain has been enlisted on one side or the other or given rise to controversies, as has been recently seen in USA. If the scientific data are accompanied with resistance and interpretation, it is evident, in some cases, that people will select their data depending on which way they want to argue, in favour of a particular thesis.

The controversies that have arisen in some states in the USA are due to the decision to anaesthetize the fetus before a voluntary interruption of pregnancy, while reading to the mother a document explaining that the fetus feels pain. Some political exponents have interpreted this as an initiative to discourage women who have decided to abort. But we cannot ignore scientific work, including that published by the authors of this volume, showing that the fetus is able to perceive pain because it is already in possession of sufficiently developed anatomical structures, and that it is able to give some physiological and behavioural responses after painful stimuli. The difference between “nociception”, verifiable by accurate studies, and “conscious recognition of a painful stimulus” is therefore of primary importance: it is on this last element that some positions rely when denying, in a not very deep way, how much is indeed verifiable in the investigations published in the present book. Talking about the consciousness of pain may be a bit nebulous when it is done in regard to contexts where it is hardly verifiable. The perception of painful stimuli and their relative transmission to the superior nervous centres, on the other hand, is well documented. Furthermore, the influence on the future life of the child of extended painful stimuli received in the fetal and neonatal stage has been demonstrated. It is in this wide-ranging way, with the future child kept always in view, that the scientific studies must be appraised: taking this approach, the opportunity to consider analgesia in the fetus is obvious.

The studies described in this book tend in this direction, allowing us to get to know the fetus better as a patient, and dealing with the delicate matter of its treatment. Fetal analgesia is an area full of future developments that are not without ethical implications. What seems to be fundamental in this field is to confirm that the exclusive interest of the patient and respect for human dignity must always be kept at the forefront in studies in humans and the application of their results.

Rome, December 2007

Ignacio Carrasco de Paula, MD PhD
Department of Bioethics
Faculty of Medicine and Surgery
A. Gemelli Hospital
Catholic University of the Sacred Heart
Rome

Contents

List of Contributors	XI
Introduction: Pain and Suffering from the Womb Onwards?	1
G. Buonocore and C.V. Bellieni	
 PART I Delivery and Pain	
1 Gonadal Hormones and Pain Modulation	5
A.M. Aloisi and I. Ceccarelli	
2 Stress and Pregnancy: CRF as Biochemical Marker	11
P. Florio, F.M. Reis, S. Luisi, M. De Bonis, I. Zerbetto, R. Battista, M. Quadrifoglio, C. Ferretti, A. Dell’Anna, M. Palumbo, and F. Petraglia	
3 Pain Control During Labour	25
C. Benedetto, M. Zonca, L. Bonino, S. Blefari, and E. Gollo	
 PART II Fetal Pain	
4 Ultrasound and Fetal Stress: Study of the Fetal Blink-Startle Reflex Evoked by Acoustic Stimuli	31
C. Bocchi, F.M. Severi, L. Bruni, G. Filardi, A. Delia, C. Boni A. Altomare, C.V. Bellieni, and F. Petraglia	
5 Prenatal Affective Exchanges and Their Subsequent Effects in Postnatal Life	35
C. Dolto	
6 Pain in the Fetus	45
G. Noia, E. Cesari, M.S. Ligato, D. Visconti, M. Tintoni, I. Mappa, C. Greco, G.P. Fortunato, and A. Caruso	

7	New Insights into Prenatal Stress: Immediate and Long-Term Effects on the Fetus and Their Timing	57
	K. O'Donnell and V. Glover	

PART III Neonatal Pain

8	Pain Assessment and Spectral Analysis of Neonatal Crying	67
	C.V. Bellieni and G. Buonocore	
9	Analgesic Procedures in Newborns	73
	L. Giuntini and G. Amato	
10	Nonpharmacological Treatment of Neonatal Pain	83
	R. Carbajal	
11	Sensory Saturation: An Analgesic Method	99
	C.V. Bellieni, M. Maffei, and G. Buonocore	
12	Pharmacologic Analgesia in the Newborn	103
	A.M. Guadagni	
13	Physical Stress Risk Agents in Incubators	109
	R. Sisto	

PART IV Pain: a Risk Factor for Brain Damage

14	Neonatal Stressors	123
	M. Delivoria-Papadopoulos and O.P. Mishra	
15	New Insights into Neonatal Hypersensitivity	131
	C.J. Woodbury	
16	From the Gate-Control Theory to Brain Programs for Neonatal Pain	141
	K.J.S. Anand	

PART V Pain and Communication

17	Disclosure of Pathology to the Newborn's Family	151
	P. Arosio	

18	Communication of Diagnosis: Pain and Grief in the Experience of Parents of Children with a Congenital Malformation	157
	L. Memo, E. Basile, A. Ferrarini, O.S. Saia, and A. Selicorni	
19	Invest in Prenatal Life: A High-Yield Stock	161
	M. Enrichi	
	Subject Index	167

List of Contributors

Anna M. Aloisi

Pain and Stress Neurophysiology Lab, Department of Physiology, University of Siena, Siena, Italy

Aldo Altomare

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Giovanna Amato

Section of Pediatric Surgery, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Kanwaljeet S. Anand

Department of Pediatrics, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, Arkansas, USA

Paolo Arosio

Neonatology, Neonatal Intensive Therapy Unit, San Gerardo Hospital, Monza, Italy

Emanuele Basile

Department of Child Psychiatry Eugenio Medea, Scientific Institute, Bosisio Parini, Lecco, Italy

Raffaele Battista

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Carlo V. Bellieni

Department of Pediatrics, Obstetrics and Reproduction Medicine, University of Siena, Siena, Italy

Chiara Benedetto

Chair C of the Department of Obstetrics and Gynaecology, University of Turin, Turin, Italy

Silvia Blefari

Chair C of the Department of Obstetrics and Gynaecology, University of Turin, Turin, Italy

Caterina Bocchi

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Carlotta Boni

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Luca Bonino

Chair C of the Department of Obstetrics and Gynaecology, University of Turin, Turin, Italy

Luca Bruni

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Giuseppe Buonocore

Department of Pediatrics, Obstetrics and Reproduction Medicine, University of Siena, Siena, Italy

Ricardo Carbajal

Centre National de Ressources de Lutte contre la Douleur, Hôpital d'Enfants Armand Trousseau, Paris, France

Alessandro Caruso

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart, Rome, Italy

Ilaria Ceccarelli

Pain and Stress Neurophysiology Lab, Department of Physiology, University of Siena, Siena, Italy

Elena Cesari

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart, Rome, Italy

Maria De Bonis

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Ada Delia

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Maria Delivoria-Papadopoulos

Neonatal Research Laboratory Drexel University College of Medicine, St. Christopher's Hospital for Children, Philadelphia, USA

Arianna Dell'Anna

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Catherine Dolto

Department of Pediatrics, Obstetrics and Reproduction Medicine, University of Siena, Italy

Marina Enrichi

Obstetric Psychoprophylaxis Service, Department of Gynecology and Human Reproductive Science, University of Padua, Padua, Italy

Alessandra Ferrarini

Department of Pediatrics, Fondazione Ospedale Maggiore, Mangiagalli e Regina Elena, Milan, Italy

Department of Pediatrics, San Giovanni Hospital, Bellinzona, Switzerland

Caterina Ferretti

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Gilda Filardi

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Pasquale Florio

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Giuseppe P. Fortunato

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart, Rome, Italy

Laura Giuntini

Department of Intensive Care, Policlinic Le Scotte, Siena, Siena, Italy

Vivette Glover

Institute of Reproductive and Developmental Biology, Imperial College London,
London, United Kingdom

Evelina Gollo

Department of Anaesthesia, OIRM S. Anna, Turin, Italy

Chiara Greco

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart,
Rome, Italy

Anna M. Guadagni

Department of Medical and Surgical Neonatology, Bambin Gesù Pediatric Hospital –
I.R.C.C.S. – Roma, Italy

Maria Serena Ligato

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart,
Rome, Italy

Stefano Luisi

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and
Reproductive Medicine, University of Siena, Siena, Italy

Ilenia Mappa

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart,
Rome, Italy

Luigi Memo

Neonatal Intensive Care Unit, S. Maria di Cà Foncello Hospital, Treviso, Italy

Om P. Mishra

Neonatal Research Laboratory, Drexel University College of Medicine, St. Christopher's
Hospital for Children, Philadelphia, USA

Giuseppe Noia

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart,
Rome, Italy

Kieran O'Donnell

Institute of Reproductive and Developmental Biology, Imperial College London,
London, United Kingdom

Marco Palumbo

Department of Microbiological and Gynecological Science, University of Catania,
Siena and Catania, Italy

Felice Petraglia

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Mariachiara Quadrifoglio

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Fernando M. Reis

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Onofrio S. Saia

Neonatal Intensive Care Unit, S. Maria di Cà Foncello Hospital, Treviso, Italy

Angelo Selicorni

Department of Pediatrics, Fondazione Ospedale Maggiore, Mangiagalli e Regina Elena, Milan, Italy

Filiberto M. Severi

Section of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Renata Sisto

ISPESL, Department of Occupational Hygiene, Monte Porzio Catone, Rome, Italy

Mauro Tintoni

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart, Rome, Italy

Daniela Visconti

Department of Obstetrics and Gynecology, Catholic University of Sacred Heart, Rome, Italy

Charles J. Woodbury

Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming, USA

Irene Zerbetto

Division of Obstetrics and Gynecology, Department of Pediatrics, Obstetrics and Reproductive Medicine, University of Siena, Siena, Italy

Marina Zonca

Chair C of the Department of Obstetrics and Gynaecology, University of Turin, Turin, Italy