Nitrous Oxide in Pediatric Dentistry

A Clinical Handbook

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Editors

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Dedicated
to all the child patients
and
pediatric dentists

Foreword

It is with great pleasure that I write a few words for my colleagues about their exciting new book. This publication provides the reader with theoretical and clinical knowledge on the use of nitrous oxide sedation, a sedation technique used in dentistry for decades, but not available to dentists in all countries. It also highlights the ever-increasing need for knowledge in the field of pediatric sedation worldwide.

India is considered one of the emerging superpowers of the world. This potential is attributed to several indicators, the primary ones being its demographic trends and a rapidly expanding economy. As such, there is a large child population and the growth in demand for dental services has forced professionals to explore and develop techniques used in the field of sedation elsewhere.

Children require specific behavior management techniques to provide them with adequate and compassionate care. Dentists address this clinical requirement with a diversity of non-pharmacological and pharmacological techniques, which differ according to country and resources. Important variables include cultural aspects, current trends in parental expectations worldwide, training and experience in the field of pediatric dentistry, and especially, education in the field of pediatric sedation. Dentists now face many challenges in the management of their young patients.

Dr. Gupta and Dr. Sethi's vision and experience among their colleagues are a sign of the new demands for services in the field of pediatric dentistry. Prof. Emmanouil brings diversity and vast experience in this field. He is a well acclaimed and renowned lecturer internationally and he continues to research on the use of nitrous oxide in our profession. As an experienced pediatric dentist myself, a sedationist and lecturer in the field of pediatric dental sedation, it is heartwarming to see colleagues join forces and edit this publication for the benefit of dentists and children overall.

This publication is a comprehensive book on the history and background, mechanism of action, and the clinical use of nitrous oxide in children. Each chapter addresses different components and the publication is well referenced. Although nitrous oxide has been around for a long time, its use in pediatric dentistry is not widespread worldwide. Increasing demand for the use of sedation in our field makes this book the perfect reference for the clinician learning the use of nitrous oxide.

I am sure this publication will become a great tool for clinicians wanting to expand their knowledge, and a second edition at some stage in future will continue its legacy.

Eduardo A. Alcaino, BDSc (Hons), MDSc (Paeds) MRACDS
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Preface

Pediatric dentistry is one of the most challenging specialities of dentistry because providing good quality clinical work to child patients is dependent not only on the clinical expertise of the operator but more importantly on the behavior guidance skills. Behavior management is an integral part of pediatric dentistry; however, many a time nonpharmacologic techniques are not adequate.

After graduating, I practiced pediatric dentistry without nitrous oxide for quite a few years. Although having seen its use in many countries, and reading about it, I always wondered why was it not used in India. Some dreams do come true, and I got an opportunity to practice this technique. Soon after, I began to realize the change it brought in my clinical practice, and I termed it as the "backbone of pediatric dentistry."

However, it has a stigma attached to it for being a "pharmacologic agent" of behavior management and is commonly but incorrectly kept at the same pedestal as general anesthesia. Aren't we doing operative/surgical procedures which do require the use of pharmacologic agents like local anesthesia? Then why do we shy away from the routine use of nitrous oxide in pediatric dentistry when, with its use, we can make fearful children grow into adults without having fear of dentistry? Why is a pediatric dentist termed an "ideal pediatric dentist" only when he/she uses non-pharmacologic behavior management?

Child is not a miniature adult, and similarly, nitrous oxide in pediatric dentistry is little different from that in adults, mainly because of the lack of adequate communication from children and lower cognitive ability than grown-ups. However, with appropriate use of behavior guidance skills, nitrous oxide can be practiced well in children. And this stimulated me to write this book, because I felt a need to highlight the integration of basic behavior guidance, which starts with recognition of fear, with nitrous oxide-oxygen inhalation sedation. This book, therefore, focusses on the use of nitrous oxide in child patients and is the first book on nitrous oxide exclusively for pediatric dentistry.

The book begins with understanding fear and anxiety. This step is crucial for a clinician to successfully practice nitrous oxide in children because one of the main purposes of nitrous oxide is to bring about anxiolysis. The synergism between basic behavior management and nitrous oxide is explained step-by-step in children with different behaviors. Various aspects of employing this technique in child patients have been supported with videos for better understanding of the readers. A chapter

has been dedicated for use of this technique in children with special healthcare needs.

Numerous other dimensions such as the mechanism behind its action, hazards and risks, equipment, and basic properties have been covered, which will make this book an enjoyable read for dentists dealing with children.

Gurugram, India Kunal Gupta
May 2019

Preface

Nitrous Oxide: The Nearly "Ideal" Clinical Sedative

I am pleased to present this book as the product of an international collaboration from authors, experts in the field of inhalation sedation. It has been an honor for me to have worked together with the young generation of India's clinicians on this book.

China and India, nearly 40% of the world's population, have lately introduced nitrous oxide in their inventory of sedation techniques. This book represents an expansion of the chapter I coauthored for the book *Behavior Management in Dentistry for Children* (editors G. Wright, A. Kupietzky, Wiley 2014), which has been translated into Chinese.

My first contact with nitrous oxide was 35 years ago in 1985 when I walked in Dr. Quock's lab at Marquette University Dental School looking for a research subject for my master's thesis. I was captivated by how psychopharmacology could replicate human attributes with animals and the innovative ways there, to test a gaseous agent like nitrous oxide. I felt I had found my calling.

Since then, nitrous oxide research took me from Marquette University to the University of Illinois and Washington State University, USA, working with Dr. Quock's team. I consider myself very fortunate to have chosen this field of study and blessed to have been able to contribute, through my research, some small pieces of the "nitrous oxide" puzzle.

A discussion of the mechanism of action of nitrous oxide, a simple inert compound of only three molecules, has also revealed a long and fascinating history, making it a "laughing gas" not only for patients but also for the researchers trying to decipher its multitude of actions.

Its popularity has been turbulent over time: used as anesthetic, then fell out of favor becoming a recreational drug; came back full force helping anesthesiologists bring faster and painless anesthesia to their patients; used in labor and in dentistry as the favorite analgesic and anxiolytic; today falling out of favor from the anesthesiology departments but gaining favor not only in dentistry but also in the emergency and outpatient hospital departments and at the same time used by young people in today's society as a recreational drug of choice and in "nitrous" bars.

This book is an attempt to bridge the new knowledge of nitrous oxide mechanism of action with its clinical application in pediatric dentistry. There is a lot of material covered with clinical tips and scientific backing, and we have tried to include all the updated literature on nitrous oxide. This book will help the reader advance the knowledge and practice of inhalation sedation with nitrous oxide. Furthermore, the clinician will also have access to videos helping to better understand the concepts of each chapter.

I would like to thank all the contributors for the excellent work on this book and my family for their support throughout the years.

Athens, Greece
May 2019

Dimitris Emmanouil

Acknowledgments

First and foremost, I would like to thank God for giving me the strength to undertake this project and pen down my passion of practicing the technique of nitrous oxide in child patients. My heartfelt thanks to my family including my parents, wife Jyotsna, and daughter Kimayra who gave me the power to believe in myself and pursue this dream.

Dr. Justin Lee needs a special recognition for being my mentor for this technique and ensuring that I employ this technique in nearly all my child patients. As a result I could gain good experience in using this technique in child patients and formulating my thoughts.

It was a great privilege and honor to have Dr. Dimitris Emmanouil as a coeditor for this book. Thank you for deciding to trust me, motivate me, and build a professional relationship which will last forever. His vast knowledge on this subject has added value to this book, which the reader will appreciate and benefit from.

I would extend my sincere gratitude to Dr. Amit Sethi who endorsed my idea of this book from its inception to its completion. Each and every contributing author of this book has done a commendable job, especially Dr. Priyanshi Ritwik who left no stone unturned to submit her contributions in time. I would like to thank Prof. Shobha Tandon who has been a constant driving force for me to undertake such projects.

I am grateful to Springer Nature, Switzerland, for consenting to publish this book. My words of appreciation are for Markus Bartels, who gave numerous suggestions to improvise the proposal and also get it approved, Narendran Natarajan and Rajesh for assisting in the production, and Alison Wolf for providing never-ending support and guidance. Mr. Pascali Pascalis from Porter needs a special mention for providing inputs and pictures for chapter on technical considerations.

My words of appreciation for Dr. Meenakshi S. Kher for contributing a video and few pictures; my colleague, Dr. Meha Kohli for her selfless support at various stages of manuscript preparation including photography, videography, referencing; Mr. Rohan Barwal for beautiful artworks, and Ms. Prerita Dobhal for meticulously proofreading the manuscript.

Last but not least, big thanks to all my friends and colleagues who appreciated my practice of nitrous oxide in pediatric dentistry. Many of them directly or indirectly motivated me and stimulated my mind to take up this task.

Gurugram, India
May 2019

Kunal Gupta

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Rationale for Using Nitrous Oxide in Pediatric Dentistry

1

Kunal Gupta and Priyanshi Ritwik

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Learning Objectives

1. Comprehending fear and anxiety in children which forms the basis for using nitrous oxide in children
2. Understanding the purpose of using nitrous oxide in children which will help in increasing its use in children
3. Studying about the indications of using nitrous oxide in children which assists in case selection
4. Knowing contraindications which will help in making this technique more efficacious and safe
5. Realizing the advantages of this technique over other modes of sedation
6. Appreciating the disadvantages of this technique in order to know its limitations

A visit to a dental clinic is always considered to be nerve-racking whether for adults or children. The "smell, the sounds", and the general atmosphere all add up to create an atmosphere which is not exactly perceived to be pleasant by most people. If you add crying children and stressed out parents to the mix, as in case with pediatric dental offices, then the situation becomes even more complex. This means that pediatric dentistry can be demanding for all the people involved and most importantly for child patients. Understanding the basics of fear and anxiety is a stepping stone towards the successful use of nitrous oxide in children as a behavior management tool. The purpose of using nitrous oxide should be clear to the pediatric dentists, in order to ensure that this technique is practiced effectively and efficaciously. It is more of a behavior guidance tool rather than a sedative tool. In this chapter, the indications and contraindications of using nitrous oxide in children shall be discussed as well as the advantages and disadvantages of its use in a pediatric dental office. A thorough knowledge about these will instill confidence in the pediatric dentists about its use in majority of their child patients.

1.1 Understanding Fear and Anxiety

The knowledge and understanding of fear and anxiety not only lays the foundation of our ability to provide the best possible care for children but more importantly allows us to establish a healthy and long-term relationship with them. It helps dentists recognize the signs of fear and anxiety, understand the underlying etiology, and enable them in developing a strategy to interact with such children. It is only after a thorough understanding of fear and anxiety that a dentist can use basic behavior guidance techniques individualized to each pediatric patient and introduce nitrous oxide in an effective manner.

1.1.1 What Is Fear?

Fear is a natural part of a child's development. Overcoming fear helps a child successfully engage and overcome a difficult situation. A child who is able to overcome a fearful situation develops a sense of achievement and becomes more confident. On the other hand, a child who gets overwhelmed by fear often chooses to "run away from the situation." In our case, it means leaving the operatory or if he chooses to stay, he does not allow the dentist to examine or treat him. Such a patient continues to remain "scared of dentists" and becomes more insecure as time passes. This perpetuates future anxiety and reluctance in accepting dental care.

Fear is defined as an unpleasant emotional response to a real or perceived immediate external threat or danger [1]. Fear comprises of psychological and psychophysiological responses. In simple terms, fear is the emotion one experiences, when there is an imminent threat of harm [2]. Fear is a protective emotion and integral to human experience. Fear is caused by specific stimuli in a context-dependent way [3].

Inability to handle a difficult situation leads to the development of fear.

1.1.2 Ages and Stages of Fear

Fears vary across ages and stages of child development (Fig. 1.1). Typically, fears vary in frequency, intensity, and duration. Fears wax and wane as a child grows; they also tend to differ based on the objects which evoke them in an age-specific and transitory way [4]. Children's fears at various age groups has been detailed in Appendix I. Knowledge about age-specific fears can be useful for the dentists when dealing with children. For eg: In a dental office, separation from parents should not be done for preschoolers as it may induce fear.

1.1.3 Development and Physiology of Fear

The neurobiology of fear remains in its infancy. From an evolutionary perspective, fear is a protective mechanism and enables one to respond appropriately when faced with danger or harm. Fear is considered as an innate function of the subcortical brain, and the amygdala is referred to as the hub of the fear circuit [2]. The role of the amygdala in processing and expressing fear is summarized in Fig. 1.2.

Amygdala is the core of fear circuit in the brain.

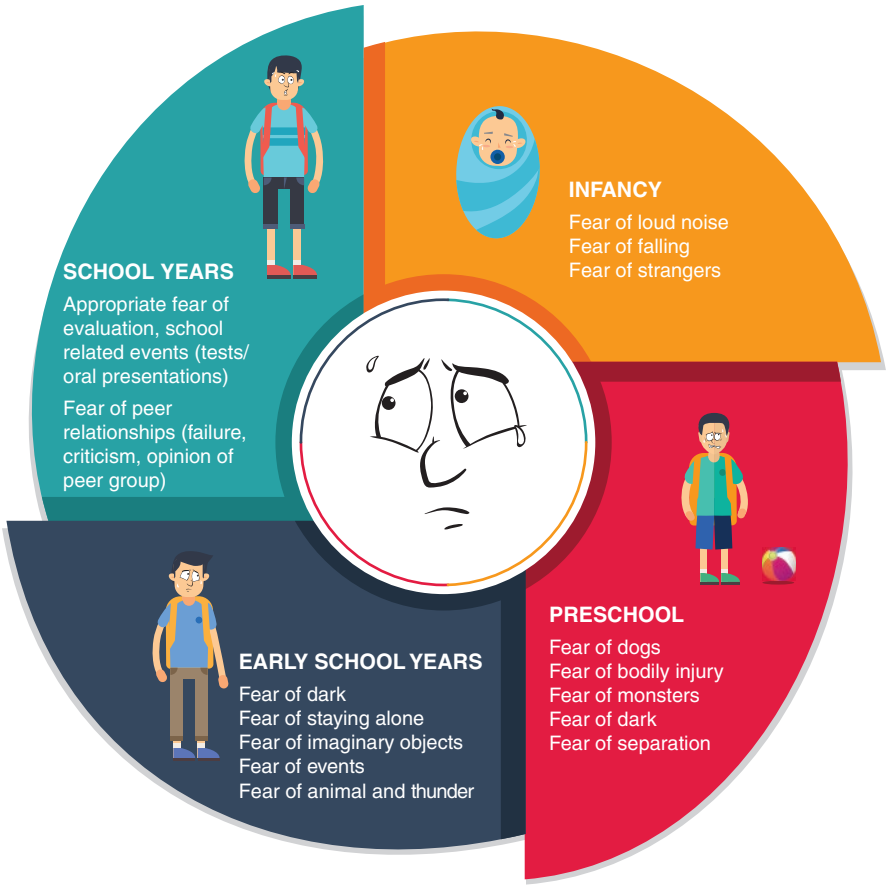

Fig. 1.1 Different kinds of fear at various age groups in a growing child

A child's fear has been explained by several theories. It may be related to the emotional involvement with their parents [5, 6] or may be a conditioned response involving learning, unlearning, and modification of fear through environmental experiences. Gesell states that children [7] go through a series of fears as they mature. Jeffrey Derevensky stated that children's fears are not unrealistic or imaginary [8].

Fear in children is mostly learned through experiences or taught by parents, teachers, siblings, or friends.

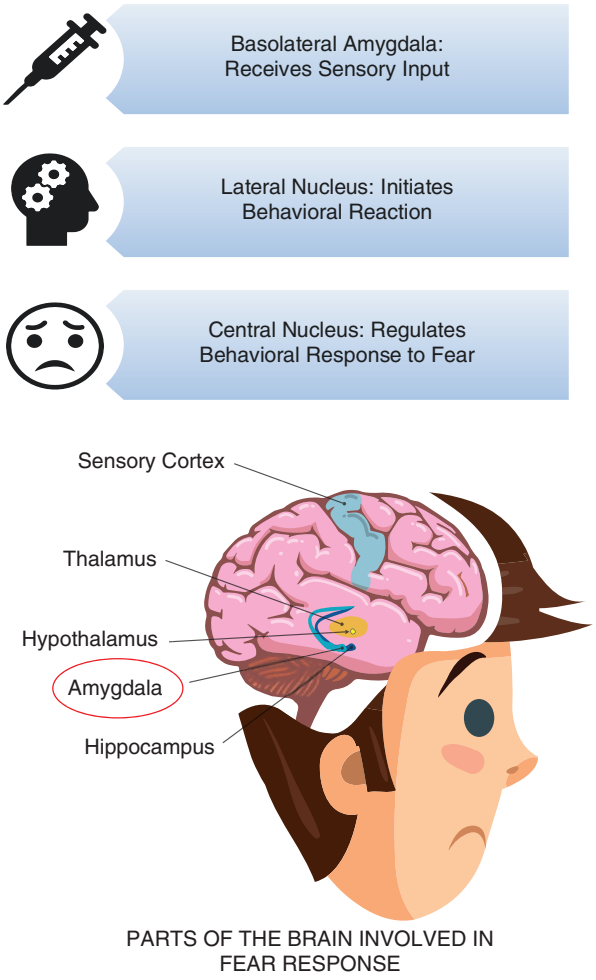

Fig. 1.2 Location and Role of the amygdala in processing and expressing response to fear

1.1.4 Responses to Fear

Stimuli that evoke fear unravel a complex cascade of behavioral, autonomic, endocrine, and cognitive responses. Broadly speaking, fear results in inner feeling/cognitive response, outer behavioral expression, and accompanying physiological changes [4]. The responses to fear are summarized in Fig. 1.3.