

Literature Review Article

Nitrous oxide for dental treatment in patients with infantile autism: a literature review

Marta Eloiza Zanelli¹
Luiz Evaristo Ricci Volpato¹
Adriana Lira Ortega²
Álvaro Henrique Borges¹
Andreza Maria Fábio Aranha¹

Corresponding author:

Luiz Evaristo Ricci Volpato
Av. José de Arruda, 3.100 – Jardim Europa
CEP 78065-900 – Cuiabá – MT
E-mail: odontologiavolpato@uol.com.br

¹ School of Dentistry of University of Cuiabá – Cuiabá – MT – Brazil.

² Cruzeiro do Sul University – São Paulo – SP – Brazil.

Received for publication: May 30, 2014. Accepted for publication: November 24, 2014.

Keywords:

autistic disorder;
conscious sedation;
nitrous oxide.

Abstract

Introduction: Childhood autism is a neurodevelopment disorder with characteristic symptoms, e.g.: impairments in social interaction and communication, restricted interests and repetitive behaviors. The dental care of these individuals is challenging because of the difficulty in social relationship presented, so that the use of auxiliary pharmacological means, as the use of conscious sedation with nitrous oxide and oxygen is indicated in managing the behavior of the patient with infantile autism. **Objective:** To perform comprehensive literature review on the use of conscious sedation with nitrous oxide as an adjunct in the behavior of the patient with infantile autism. **Literature review:** The following descriptors were used: autistic disorder, conscious sedation and nitrous oxide in national and international databases at the period from 2006-2014. **Conclusion:** The conscious sedation with nitrous oxide and oxygen, as an auxiliary method in the behavior management of children with autism is a secure and effective option, through previous evaluation of the individual, in order to achieve the expected results.

Introduction

Autism is a neurodevelopmental disorder characterized by impaired social interaction, communication and restricted and repetitive behaviors [3]; it first appears during infancy or

childhood, and generally follows a steady course without remission [44]. It ranks third place among child development disorders in front of congenital malformations and Down's syndrome [21]. The evident symptoms start gradually after the age of 6 months, establish at the age of 2 or 3 years and

tend to continue into adulthood [16, 36]. It presents multifactorial etiology: of organic biologic or genetic basis and environmental factors [19, 24].

The autist should be assisted by the dentist for prevention and treatment of oral diseases as similar as any other patient, because common dental problems are present - high plaque index, dental caries, gingivitis, malocclusion - resulting from cariogenic diet, poor oral hygiene, medications and parafunctional habits [16, 30, 32].

Generally, the treatment of these patients is difficult because of the difficulties related to the interaction of people with autism and their difficult behavior [5, 9, 12, 31, 36, 39, 40]. Among the behavior managements of the patient with autism, there are the psychological, which are the same used in pediatric dentistry, such as: tell-show-do, distraction, desensitization, voice control, positive reinforcement or gratification and modeling. However, these methods are difficult to be applied in patients with autism [16], so it may be necessary other managements such as pharmacological agents, including nitrous oxide [38]. Conscious sedation in dentistry, through the use of nitrous oxide gas is commonly applied in special management of the patient with special needs [13].

Nitrous oxide acts on the nervous system, has analgesic and sedative properties, reassures the patient quickly and safely, reducing its sensitivity to pain [22]. Thus, this gas is helpful in child clinical dental care as it is safe and effective, decisively influencing on the behavior and decreasing the anxiety levels during the sequence of appointments [42].

This study aimed to review the literature on the use of conscious sedation with nitrous oxide gas as an adjunct in the behavior management of the patient with infantile autism. For this purpose, the following descriptors were used: autistic disorder, conscious sedation and nitrous oxide, in national and international databases (Lilacs, Medline, and Scielo) in the period from 2006-2014.

Literature review

Etiology, epidemiology and classification

Autism is still a big unknown to science. Researchers try to seek answers to their cause, which in many individuals seems to be related to multiple factors. It is also believed that autism origin is in abnormalities in some region of the brain, not yet conclusively defined [20].

Among the causes of autism, there are associations with genetic and congenital conditions such as: lactic acidosis, oculocutaneous albinism, change in purines, hearing impairments, progressive muscular dystrophy, tuberous sclerosis and phenylketonuria. Also, associations with various syndromes such as Moebius, Cornelia de Lange, Down, fetal alcoholic, Goldenhar, Laurence-Moon-Biedl, Noonan, Rett, fragile X syndrome and Williams can be cited. In addition, some cases may be related to prenatal non-genetic factors such as chemical exposure during pregnancy, mumps, cytomegalovirus, herpes, rubella, toxoplasmosis, syphilis and varicella [30]. Another hypothesis for the cause of autism is related to mercury. Many infants are born with a genetic predisposition to retain heavy metals (copper, lead, aluminum, mercury, etc.) instead of the body excrete them. The biggest problem is caused by mercury contained in childhood vaccines, as this can remain in the bloodstream for about 6 months after exposure and can concentrate in the brain, staying hidden and causing severe degeneration of neurons [30]. Thus, it is considered that there are indisputable evidence that autism have a biological basis, a strong genetic component and environmental factors [19].

General care directed to all pregnant women is which is recommended for the prevention of autism, especially care in using chemicals, medicines, drugs, alcohol or smoking [20].

Usually the diagnosis of autism is made through the Leiter international Performance Scales (LIPS), which evaluates the mental age and intelligence quotient, and the Diagnostic Checklist for Behavior Disturbed Children - E2, created by Rimland in 1964, which assesses children less than five years of age, and consists of a questionnaire of 80 items, answered by the parents [46].

Autism is presented in different combinations of symptoms and degrees of severity associated with IQ (IQ), ranging from moderate to profound (below 70) and severe mental retardation, which is the low-functioning autism, to the normal or over endowed intelligence quotient (IQ), which is the high-functioning autism. Between 10 and 20% of children have scores within the normal range [46].

Behavior characteristics

The term autism comes from the Greek *autos* and denotes the behavior of "turn to himself" [45]. It is characterized by changes in behavior patterns, which are restricted

and repetitive with different levels of severity, causing losses in reciprocal social interactions, communication shifts, and limited, stereotyped behavior standards [46]. It begins until the ending of the third year of life, with prevalence four times higher in males than in females [6, 25]; however, girls tend to be more seriously affected and have a history of higher cognitive impairment [43].

This syndrome was presented by Leo Kanner and Hans Asperger in 1943, based on 11 cases of children followed-up by them and who had some characteristics in common: the inability to relate to others, severe language disorders and obsessive concern for what is unchangeable [14, 23].

Among the main behavioral characteristics of infantile autism are non-establishment of eye contact, various stereotyped behaviors and language delay. Language problems are usually in the form of echolalia, which is the involuntary repetition of words spoken by others, reversing pronouns, as in the confusion between "me" and "you" and repetitive questions [30]. Autists do not understand emotions, subtleties, ulterior motives, ironies, passions and sorrows. Hardly make connections with people and are connected to object and the spaces where they live [30]. Changes in their daily routine, such as house, furniture or even the route may increase self-harm [30]. Hypersensitivity transforms physical contact and certain sounds in torture for these children; bright lights, including the dental chair light, can be distressing or fascinating for them [38].

Self-mutilation is a very present among autistic behavior, in order to get the attention of parents or caregivers. About 5% of patients with different psychiatric conditions present self-mutilating behavior; in autistic patients, the number rises to 70% [38]. In the mouth, self-injury appears as injuries in the gums, ulcers on the tongue and lips and even cases of self-extracting teeth. A suggested therapeutic technique for these cases is to reinforce behaviors that do not involve self-injury and ignore undesirable behaviors. However studies with autistic families report that the control of self-mutilation is one of the greatest difficulties found [38].

A recent study evaluating the oral health of children with autism has shown that they had a higher prevalence of caries, poor oral hygiene and extensive dental needs, when compared to non-autistic children. Thus, an oral health program that emphasizes prevention is considered especially important for children and young people with autism [28].

Treatment methods for the patient with autism

The treatment of autistic children and adults should seek not only their standardization, but the attenuation of the losses presented, if possible [26]. Some methods are designed to assist children and adults with autism, respecting the limitations [8].

The method of Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH) is based on the organization of the physical space through routines organized in boards, panels and agendas. The following stimuli are used: visual (photos, pictures, cards), body (act of pointing, gestures, body movements), audio and kinesthetic (sound, word, movement associated with pictures). The TEACCH support points are: a well-defined physical structure, with each room for a function; activities sequence and the children know what is required of them and the direct use of visual aids such as cards and murals [8]. There are positive reports of the use of this method in the dental environment [34].

One method often used is also the Pictures for Communication System (PECS), which seeks to help autistic to realize that, through the communication figures the desired things will be obtained faster. It is an auxiliary method in the development of communication between the professional and the patient, trying to implement a "way" of communication between the autistic and the surrounding environment. Some autistic children develop the so-called traditional language, although others may never speak, but may use a precise instrument to relate to the world and express their concerns and desires. The PECS proposes that the autistic replaces a picture or photo for wanted something [8].

Another method is the Applied Behavior Analysis (ABA), which seeks to teach skills that the patient with autism does not have, in stages. Much importance is given to reward or reinforcement of desired and appropriate behaviors is given, ignoring, minimizing and discouraging inappropriate behavior by redirecting the patient to other attitudes [8].

In the Son-Rise® program, all learning takes place in the context of a fun, loving and dynamic interaction. The emphasis is on fun and activities are adapted so that they are motivating and appropriate to the particular stage of development of the individual, whatever their age. The program proposes the use of toys and motivational materials that serve as facilitating tool for interaction and

subsequent cooperation. This program is based on the acceptance of people with autism associated with a Positive attitude – of enthusiasm and hope [46]. It is also possible to use body language, so the professional, through their facial expressions, can transmit to the child satisfaction due to good behavior. [29].

Depending on the degree of mental behavior, dental treatment of autistic patients on an outpatient basis is feasible [31, 32]. Some details must be observed during the treatment, such as: elimination of stressful sensory input, clear and objective orders and establishing a routine care [1, 5]. The sessions should be short and organized. Because these patients have a fascination with rotary motion, like staring at spittoon and fans, and the behavior control may be necessary [37, 40].

There are also physical restraint methods, which aim to protect and provide security for the child because the dentist uses cutting materials that can cause injury to the patient in case of quick and unexpected movements. In this case, a previous explanation to the patient is necessary, in accessible language so it does not interpret this procedure as aggression or punishment for not being collaborating. The physical restraint or protective stabilization can only happen with the consent form signed by the parents. Parents should be advised and can collaborate, gently holding the child's arms and legs [29].

Another option is the Holding Therapy held in order to involve the patient in forced hugs that theoretically pass through the phases to resist, give in and accept. The purpose of this technique is to force a body contact to make it acceptable, in order to overcome the natural tendency of autistic to isolation [2].

Despite the existing techniques for addressing child with autistic, which makes dental care difficult is that the parents seek treatment at 7 and 14 years of age, and commonly the patient needs curative treatments. So it is important that autists have contact with the dentist as early as possible, aiming at the routine treatment [23].

Given the above, it is essential that the dentist recognize this deviant behavior in order to provide an effective and specific dental approach [12, 31]. The link among the dentist, the patient and family is vital to enable successful treatment on an outpatient basis, seeking the reduction of care under general anesthesia [28].

Conscious sedation with nitrous oxide

Conscious sedation through the use of nitrous oxide gas in combination with oxygen gas in dentistry is commonly applied on the patient with special needs, i.e., individuals who have congenital malformations, behavioral disorders, communication disorders, acquired physical changes, among other [10], and whose dental treatment depends on eliminating or circumventing the existing difficulties due to a limitation in the emotional, intellectual or social area [27].

Nitrous oxide is a colorless, non-irritating gas with sweet odor and mild taste. It is an inert inorganic compound, non-explosive, non-flammable, but facilitates the combustion of other substances [41]. Its advantage over benzodiazepines it is the fast start, and the dosage is obtained incrementally by inhalation [10]. It acts on the nervous system, has analgesic and sedative properties, promotes a slight depression of the cerebral cortex, does not depress the respiratory center, keeping the larynx reflexion. It reassures the patient quickly and safely by decreasing sensitivity to pain [13]. Its poor solubility in blood and tissues promotes appropriate pharmacokinetic properties with a volatile agent, taking as a parameter that its uptake and distribution are very fast, as well as its elimination [15]. The speed of transport through biological membranes is high, leading to effective specific and global effects on the central nervous system. Therefore, in about five minutes it reaches the ideal level of sedation, and the patient is quiet, responsive and relaxed for the procedure to take place. In the end, within minutes, it will be free to implement the routine activities [33].

The Resolution No. 51/2004 of the Federal Council of Dentistry has standards for qualification of the dentist in the implementation of the analgesia or conscious sedation with nitrous oxide. According to this resolution, the dentist should participate in a regulated course, that meets the programmatic content and a minimum workload of 96 (ninety six) hours [7]. Thus, the sedation with nitrous oxide is allowed in dental office with the presence of an enabled dentist or an anesthesiologist [18]. The use of conscious sedation by trained professionals remains a valuable safe and effective therapy in the management of the patient in order to be possible the implementation of the dental procedure, in an outpatient setting [35].

Nitrous oxide in the management of the patient with infantile autism

Patients with disabilities, likely to autists, benefit from sedation in various situations, since

they can have behavioral problems and do not cooperate with dental care that limits them to understand instructions [11].

It is important to obtain details of the medical history of the child on the reaction prior to sedation, because a longer administration and concentrations of nitrous oxide higher than usual can be required to achieve the desired level of sedation in autistic patients [18], and in some cases it may be inadvisable [24].

The success of the technique is the analysis of the response of the patient. Before the first use in the day, they should be checked: oxygen supply, amount of nitrous oxide operation of the flowmeter, cleaner operation and the availability of drugs [18].

The selected facial mask should be the one that best adapts to the anatomy of the patient. The adjustment of the oxygen flow usually ranges from 6 to 7 L/min for adult patients and 4 to 5 L/min for children. The device is set to release 100% oxygen. After determining the flow and check the mask-fit on the patient the release of nitrous oxide begins at increments, usually 10% every minute until obtaining a good level of sedation achieved by the relax and well-being of the patient [17]. The determination of the optimal sedation is subjective and varies from patient to patient, but is always limited to a maximum of 70% nitrous oxide. Importantly, even when using the maximum concentration, an extra oxygen concentration is offered, about 50% more than the atmospheric air [4].

The conscious sedation technique by inhalation with a mixture of nitrous oxide and oxygen has been widely used in various countries in the dental field, without the occurrence of serious complications for patients. Nitrous oxide has analgesic and sedative effect, enhancing the effect of the local anesthetic, does not lead to drug dependence and, as it is not metabolized by the body, has no toxic effect. In terms of safety, the technique is considered the safest procedure of drug sedation [33]. Conscious sedation with nitrous oxide should not be used indiscriminately, but for specific dental procedures and situations where the patient benefits from conscious sedation as a pharmaceutical method for controlling the behavior, anxiety, pain and fear [4].

Conclusion

Conscious sedation with nitrous oxide and oxygen as an auxiliary method in the behavior management of children with autism undergoing dental treatment is a safe option, rapidly reversible

and favoring care in an outpatient setting, reducing the use of general anesthesia and hospitalization. Its indication must be preceded by the patient assessment, since the technic introduction requires certain cooperation in order to get obtain right proposed and expected sedation levels.

References

1. Aguiar AS, Santos Pinto R. Assistência odontológica a autistas. Relato de casos clínicos. RGO. 1992;40(5):345-9.
2. Amaral COF, Malacrida VH, Videira FCH, Parizi AGS, de Oliveira A, Straioto FG. Paciente autista: métodos e estratégias de condicionamento e adaptação para o atendimento odontológico. Arch Oral Res. 2012 May-Aug;8(2):143-51.
3. Amaral DG, Schumann CM, Nordahl CW. Neuroanatomy of autism. Trends Neurosci. 2008;31:13745.
4. Arnez MFM, de Queiroz AM, Stuaní MBS, Silva FWGP. Sedação consciente: recurso farmacológico para o atendimento odontológico de crianças e pacientes especiais. Pediatría. 2011;33(2):107-16.
5. Barry S, O'Sullivan EA, Toumba KJ. Barriers to dental care for children with autism spectrum disorder. Eur Arch Paediatr Dent. 2014 Apr;15(2):127-34.
6. Bosa CA. Autismo: intervenções psicoeducacionais. Rev Bras Psiquiatr. 2006;28(Supl 1):S47-53.
7. Brasil. Conselho Federal de Odontologia. Resolução 51/2004 de 30 de abril de 2004: baixa normas para habilitação do CD na aplicação da analgesia relativa ou sedação consciente com óxido nitroso. 2004.
8. Callahan K, Shukla-Mehta S, Magee S, Wie M. ABA versus TEACCH: the case for defining and validating comprehensive treatment models in autism. J Autism Dev Disord. 2010;40(1):74-88.
9. Capozza LE, Bimstein E. Preferences of parents of children with autism spectrum disorders concerning oral health and dental treatment. Pediatr Dent. 2012 Nov-Dec;34(7):480-4.
10. Cogo K, Bergamaschi CC, Yatsuda R, Volpato MC, Andrade ED. Sedação consciente com benzodiazepínicos em odontologia. Rev Odont da UNICID. 2006 May-Aug;18(2):181-8.

11. Coke JM, Edwards MD. Minimal and moderate oral sedation in the adult special needs patient. *Dent Clin North Am.* 2009;53(2):221-30.
12. Delli K, Reichart PA, Bornstein MM, Livas C. Management of children with autism spectrum disorder in the dental setting: concerns, behavioural approaches and recommendations. *Med Oral Patol Oral Cir Bucal.* 2013 Nov 1;18(6):e862-8.
13. Dualibi SE, Dualibi MT. Uma nova visão sobre conceito e classificação em pacientes especiais. *Revista Paulista de Odontologia.* 1998;(2):28-33.
14. Deruelle C, Rondan C, Gepner B, Fagot J. Processing of compound visual stimuli by children with autism and Asperger syndrome. *Int J Psych.* 2006;41(2):97-106.
15. Eger EI 2nd, Larson Jr CP. Anaesthetic solubility in blood and tissues: values and significance. *Br J Anaest.* 1964 Mar;36:140-4.
16. El Khatib AA, El Tekeya MM, El Tantawi MA, Omar T. Oral health status and behaviours of children with Autism Spectrum Disorder: a case-control study. *Int J Paediatr Dent.* 2014 Jul;24(4):314-23.
17. Falqueiro JM. Analgesia inalatória por óxido nitroso/oxigênio. 1ª ed. São Paulo: Santos; 2004.
18. Fanganiello M. Analgesia inalatória por óxido nitroso e oxigênio. 1ª ed. São Paulo: Artes Médicas; 2004.
19. Farrel M. Dificuldades de comunicação e autismo: guia do professor. Porto Alegre: Artmed; 2008.
20. Frith U. The neurocognitive basis of autism. *Trends Cogn Sci.* 1997;1(2):73-7.
21. Gadia CA, Tuchman R, Rotta NT. Autismo e doenças invasivas do desenvolvimento. *J Pediatr.* 2004;80:1-12.
22. Gaujac C, Santos HT, Garção MS, Silva Júnior J, Brandão JRMCB, Silva TB. Sedação consciente em odontologia. *Rev Odont da UNICID.* 2009 Sep-Dec;21(3):251-7.
23. Gena A. The effects of prompting and social reinforcement on establishing social interactions with peers during the inclusion of four children with autism in preschool. *Int J Psych.* 2006;41(6):541-54.
24. Gandhi RP, Klein U. Autism spectrum disorders: an update on oral health management. *J Evid Based Dent Pract.* 2014 Jun;14 Suppl:115-26.
25. Gómez S, Torres R, Ares E. Revisión sobre el autismo. *Rev Latinoam Psic.* 2009;41(3):555-70.
26. Gordon K, Pasco G, McElduff F, Wade A, Charman T, Howlin P. A communication-based intervention for nonverbal children with autism: what changes? Who benefits? *J Consult Clin Psychol.* 2011;79(4):447-57.
27. Guedes-Pinto AC. *Odontopediatria.* 4ª ed. São Paulo: Santos; 1993.
28. Jaber MA. Dental caries experience, oral health status and treatment needs of dental patients with autism. *J Appl Oral Sci.* 2011;19(3):212-7.
29. Josgrilberg EB, Cordeiro RCL. Aspectos psicológicos do paciente infantil no atendimento de urgência. *Odontol Clín Cient.* 2005;4(1):13-7.
30. Katz CRT, Vieira A, Meneses JMLP, Colares V. Abordagem psicológica do paciente autista durante o atendimento odontológico. *Odont Clín Cient.* 2009;8(2):115-21.
31. Limeres-Posse J, Castaño-Novoa P, Abeleira-Pazos M, Ramos-Barbosa I. Behavioural aspects of patients with Autism Spectrum Disorders (ASD) that affect their dental management. *Med Oral Patol Oral Cir Bucal.* 2014 Sep 1;19(5):e467-72.
32. Machuca-Portillo G, Cabrerizo-Merino C, Cutando-Soriano A, Giménez-Prats MJ, Silvestre-Donat FJ, Tomás-Carmona I. Consensus Report of the XI Congress of the Spanish Society of Odontology for the Handicapped and Special Patients. *Med Oral Patol Oral Cir Bucal.* 2014 Sep 1;19(5):e495-9.
33. Malamed SF. Sedation a guide to patient management. 4ª ed. St Louis: Mosby; 2003.
34. Orellana LM, Martínez-Sanchis S, Silvestre FJ. Training adults and children with an autism spectrum disorder to be compliant with a clinical dental assessment using a TEACCH-based approach. *J Autism Dev Disord.* 2014 Apr;44(4):776-85.

35. Roelofse JA. What's new in paediatric conscious sedation in dentistry? SAADDig. 2010;26:3-7.
36. Sanefuji W, Ohgami H. Imitative behaviors facilitate communicative gaze in children with autism. *Inf Ment Health Journal*. 2011;32(11):134-42.
37. Silk T, Rinehart N, Bradshaw J, Tonge B, Egan G, Cunnington R et al. Visuospatial processing and the function of prefrontal-parietal networks in autism spectrum disorders: a functional MRI study. *Am J Psychiatry*. 2006;163(8):1440-3.
38. Silva RAB, Mora ZG, Andrade PER, Queiroz AM. Autismo: aspectos de interesse ao tratamento odontológico. *Odontol Clín Cient*. 2008;7:191-6.
39. Stein LI, Lane CJ, Williams ME, Dawson ME, Polido J5, Cermak SA. Physiological and behavioral stress and anxiety in children with autism spectrum disorders during routine oral care. *Biomed Res Int*. 2014;694876:1-10.
40. Stein LI, Polido JC, Cermak SA. Oral care and sensory over-responsivity in children with autism spectrum disorders. *Pediatr Dent*. 2013 May-Jun;35(3):230-5.
41. Szymanska J. Environmental health risk of chronic exposure to nitrous oxide in dental practice. *Ann Agric Environ Med*. 2001;8:119-22.
42. Veerkamp JS, Gruythuysen RJ, Hoogstraten J, van Amerongen WE. Anxiety reduction with nitrous oxide: a permanent solution? *ASDC J Den Child*. 1995 Jan-Feb;62(1):44-8.
43. Weigelt S, Koldewyn K, Kanwisher N. Face identity recognition in autism spectrum disorders: a review of behavioral studies. *Neurosci Biobehav Rev*. 2012;36:1060-84.
44. World Health Organization. Pervasive developmental disorders. In: *International Statistical Classification of Diseases and Related Health Problems (ICD-10)*. Geneva; 2006.
45. Yanqing G. Training parents and professionals to help children with autism in China: the contribution of behavior analysis. *Int J Psych*. 2006 Dec;41:523-6.
46. Zink AG, de Pinho MD. Atendimento odontológico do paciente autista - relato de caso. *Rev ABO Nac*. 2008;16:313-6.