

Relationship between Mandibular Nerve Block Anesthesia and Body Mass Index in Children

Relación entre la Anestesia del Nervio Mandibular
y el Índice de Masa Corporal en Niños

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ABSTRACT: The aim of this study was to observe the relationship between the anesthetic block success (ABS) of mandibular nerve, by injecting 1.8 ml of lidocaine 2% with epinephrine 1:100,000, in children and their body mass index (BMI). A prospective cohort study was designed. A sample of 93 6-13 years children attended in JUNAEB Dental Module of Frutillar between April and July 2011. We recorded age, gender, reason for tooth extraction and tooth type (permanent or deciduous). BMI was calculated for each child and categorized into two cohorts of study according to WHO criteria: those with a BMI <p85 were defined as "low - normal weight" (LNW) and those with a BMI equal or >p85 as "over weight - obese" (OWO). After applying the anesthetic technique, effect was evaluated at 10 minutes recording its effectiveness. We analyzed statistically significant relationship between ABS and BMI using Fisher's exact test with ($p < 0.05$). Anesthetic effect was achieved in 84 children (90.3%) with a 89.36% in LNW group and 91.30% in OWO group. There was no statistically significant relationship between ABS and BMI ($p=1.0$). There is no relationship between anesthetic effectiveness of mandibular nerve and body mass index in children.

KEY WORDS: local anesthesia, body mass index, children, mandibular nerve.

INTRODUCTION

Anesthetic block of mandibular nerve and its branches (ABMN) in children is used for rehabilitation treatment, endodontics and dental extractions (Escobar, 2004). It has a failure rate between 15% and 20% (Malamed, 2006), that may be due to the anesthetic solution, expiration or more frequently by a technical (anatomic) error; may be a failure due to biological reasons, such as local inflammation that determine a low pH (Escobar) or anatomic variations such as accessory sensory innervation of mandibular teeth by the accessory cervical and mylohyoid nerves (Malamed). On the other hand, we must consider the pharmacokinetics of drugs, given that there are factors that may affect its distribution, like: binding to plasma proteins, body composition and regional blood flow (Passannante & Rock, 2005).

Although it has not been studied at length, the plasma protein binding does not appear to be

significantly different in obese individuals given that blood volume increases directly with body weight and that many patients have an increased cardiac output. This point has implications regarding anesthetic, both injected and inhaled. Still, the obesity pandemic has not led to an increase in pharmacokinetic studies in obese patients (Passannante & Rock).

Currently there are no published studies who report the association between obesity, measured through Body Mass Index (BMI), and local anesthesia, considering BMI as the best anthropometric indicator for diagnose overweight and obesity in children between 2 and 18 years old (Burrow *et al.*, 2004). In addition, the variability of success rates for ABMN reported between 10% to 39% (Fernandez *et al.*, 2005) highlights the importance to observe whether the different levels of BMI in children could affect the effectiveness of local anesthesia in dental procedures.

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The aim of this study is to observe the relationship between the anesthetic block success (ABS) of mandibular nerve, by injecting 1.8 ml of lidocaine 2% with epinephrine 1:100,000, in children and their BMI.

MATERIAL AND METHOD

A prospective cohort study was designed. We performed a simple random sampling of children whose attended in JUNAEB Dental Module of Frutillar, between April and July 2011. Selection criteria were: children between 6 and 13 years, indicating the extraction of premolar or molars (permanent or deciduous), health status ASA I and II. We excluded all patients with: acute dentoalveolar abscess, difficult management, psychological disorders or who were consuming drugs that altered pain perception.

Ethical considerations, in selected patients parents, as the legal representatives, were asked to participate in this research with the approval of informed consent form provided by the Department of Health of Frutillar. Likewise, the child was asked at the time of attention for his/her consent to participate in the study.

Examination and clinical history was performed, recording: name, sex, age and diagnosis of tooth to be extracted. BMI was calculated based on Quetelet ($BMI = \text{weight} / \text{height}^2$) and its percentile values for classifying nutritional situation among children and adolescents based on WHO criteria (MINSAL, 2004) whose distribution is: underweight <p10, normal between p10 and <p85, p85 up to p94 for overweight and obese for greater than or equal to p95 (Loaiza *et al.*, 2009). Each child was measured and weighed with a DETECTO® (Colombia) stadiometer with balance. This procedure was performed by two investigators (AC and VC), previously calibrated by a Nutritionist of Frutillar Health Service. After determining the BMI of each patient, they were classified into two weight cohorts according to WHO criteria:

- Low – normal weight (LNW): is a group of children classified with a BMI which was percentile <p85.
- Over weight - obese (OWO): is a group of children classified with a BMI percentile over or equal to p85.

Anesthetic Technique: An investigator (VC) proceeded to ABMN as described by Malamed. For this purpose, dried mucosa with a cotton ball in the retromolar trigone, then applied a benzocaine 20% topical anesthetic gel

(Mayon®, Chile) and waited for a minute. Anesthesia cartridge was heated up to body temperature over a burner and then proceeded to anesthesia of MN and its branches: the inferior alveolar nerve, lingual nerve and buccal nerve, using a 27G syringe needle carpule 0.4 mm x 25 mm (Terumo Corporation, Japan), by injecting 1.8 ml (1 tube) of lidocaine 2% with epinephrine 1:100.000 (Ortocaine 100®). As described by Escobar the puncture site is a depression mucosa, at that point, formed by the medial pterygoid muscle, going from the opposite side (distal cusp of the 2nd molar) at a depth of 8 or 10 mm from the surface, it reaches the vicinity of the foramen, which is surrounded by foraminas. This facilitates the diffusion of the solution. Thus, after the puncture aspiration was performed to verify that we are not inside a blood vessel.

Lingual nerve was anesthetized at middle distance of the withdrawal of the needle and buccal one through anesthesia infiltration in the anterior border of the ramus and laterally to retromolar trigone.

After 10 minutes, ABMN was checked by sindesmotomy, if patient reported pain or discomfort, we waited an additional 5 minutes. ABS was defined as the possibility to perform the extraction of the tooth with no pain or minimal pain tolerated by the patient. Otherwise, it was considered ineffective, strengthening the technique by injecting 0.9 ml to MN or infiltrating at buccal side of tooth.

In statistical analysis, to calculate sample size, we considered a target population of 280 6 to 13 years children attended during the months of the study, 90% of anesthetic success (Fernandez *et al.*), a margin of error of 5% and statistical significance of 5%, obtaining a estimation of 93 children.

Descriptive statistics was applied, chi square and t-test was used to determine significant differences between LNW and OWO groups for control variables (age, sex and tooth type). We analyzed statistically significant relationship between ABS and BMI using Fisher's exact test. All statistical calculations were analyzed with a significance level of $p < 0.05$ using STATA 10.0 (StataCorp, USA).

RESULTS

There were 313 patients, of which 145 met the selection criteria. Finally, 93 children agreed to

participate in the study with a mean age of 9.03 years (SD = 1.72 min = 6 max = 13). Of these, 49 were men (52.7%) and 50.53% belong to LNW group. There were no statistical differences in gender ($p = 0.35$), age ($p = 0.30$) and type of teeth extracted ($p = 0.14$) between the two groups (Table I).

Table I. Clinical and demographic characterization of patients by weight groups.

		Weight group		p value
		LNW	OWO	
Sex	Male	27	22	0.35*
	Female	20	24	
Age	Mean (SD)	9.21 (1.84)	8.84 (1.59)	0.30**
Tooth type	Deciduous	38	42	0.14*
	Permanent	9	4	

*chi square and ** t-test

Most of extractions corresponded to deciduous teeth (93.75%). Main reason for extraction were for orthodontic indications ($n = 44$), followed by decay ($n = 33$) and the rest due to physiological mobility near to exfoliation ($n = 16$).

Anesthetic effect was achieved in 84 children (90.3%) with a 89.36% in LNW group and 91.30% in OWO group. There was no statistically significant relationship between ABS and BMI ($p=1.0$). The details of these results are shown in Table II.

Table II. ABS by weight group.

Weight group	ABS		p-value
	Yes	No	
LNW	42	5	1.00*
OWO	42	4	
Total (%)	84 (90.32)	9 (9.68)	

*Fisher's exact test

DISCUSSION

In this study we observed a high rate of ABS for MN in pediatric patients treated for both primary and permanent teeth extractions. However, there was no statistically significant relation with BMI.

Our study reported a 9.7% anesthetic failure, a result similar to the ranges published by Goodman *et al.* (2006). Haase *et al.* (2008) reported that buccal nerve infiltration can reduce the failure rate and the onset of pulpal anesthesia after ABMN. Furthermore, the same author reports that 4% articaine with

1:100,000 epinephrine is superior to lidocaine 2% with epinephrine 1:100,000 in buccal infiltration in the mandibular first molar.

Using a single cartridge of 1.8 ml for ABMN is sufficient to achieve ABS, this has been proved by Foster *et al.* (2007) who shows that there were no significant differences in ABS with either 1.8 ml or 3.6 ml volume of lidocaine. In addition, it minimizes potential complications and adverse reactions because children are more likely to develop toxic reactions than adults due to their lower anatomical proportions (Wright *et al.*, 1989).

ABS seems be related to dentist-factors (initial dose administered, surgical procedure, oral premedication) and children characteristics and behavior, like: age, gender, arch treated, anxiety level and the presence of symptoms before injection (Nakai *et al.*, 2000).

Also, the pain is associated with anxiety what can distort the level of consciousness causing an increase in awareness of surroundings objects or situations, nonspecific reactivity to pain and vegetative reactions (Amez-Atapoma & Díaz-Pizán, 2010). When there is no pain and anesthetic effect is achieved, the child feels comfortable, this being good for child and dentist (Welbury, 2005).

Theories of ABMN failure include cross-innervation, accessory innervation, precision placement of the needle, anesthetic solution migration through tissues of least resistance, core theory, anxiety and psychological factors (Clark *et al.*, 2002). This is the reason because anxious and difficult to manage patients were excluded from this study. However, there are other possible biases in this study.

Moreover, the position of the mandibular foramen varies with age of child, at 4 years or less, the hole is located below the plane of occlusion. In a young child, hole is in the occlusal plane. As the child matures, it moves to a higher position (Ram & Peretz, 2002), factor that can cause a ABMN failure if anatomic development is not considered.

In relation to the weight of patients, there was no statistical association with the

anesthetic effect. Although the accuracy of BMI to estimate body composition is debatable, being affected by sex, race and age, which may lead to misclassification of obesity status (Baumgartner *et al.*, 1995).

We must highlight that there are no published studies about relation between effectiveness of local anesthesia in dentistry with the patient's weight. There are only reports that compare different types of anesthesia, volumes and concentrations, the majority focused on adult population.

Therefore, it is recommended to perform (descriptive or analytical) observational studies and randomized controlled trials, assessing effectiveness of different local anesthetics and their relation with fat percentage, measured by skinfold thickness. As well,

to evaluate pharmacokinetics of local anesthetics used in dentistry, because it is not certain whether individual anthropometric factors can influence on ABS in both pediatric and adult patients.

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RESUMEN: El objetivo de este trabajo fue observar la relación entre el bloqueo anestésico efectivo (BAE) del nervio mandibular, inyectando 1,8 ml de lidocaína al 2% con epinefrina 1:100.000, en niños y su índice de masa corporal (IMC). Fue diseñado un estudio de cohorte prospectivo. Se seleccionó una muestra de 93 niños que se atienden en el Módulo Dental de JUNAEB de Frutillar entre abril y julio de 2011. Se registró edad, sexo, motivo de la exodoncia y tipo de diente (permanente o deciduo). Se calculó el IMC para cada niño, que fue categorizado en 2 cohortes de acuerdo al criterio de la OMS: "bajo peso – normal" (BPN) para aquellos con un IMC <p85 y "sobre peso – obeso" (SPO) para con IMC igual o >p85. Después de aplicar la técnica anestésica, a los 10 minutos se evaluó su efectividad registrando el BAE. Se analizó la relación estadística entre IMC y BAE mediante Test exacto de Fisher ($p < 0,05$). Se logró el BAE en 84 niños (90,3%), con un 89,36% en el grupo BPN y 91,30% en el grupo SPO. No se halló una asociación estadísticamente significativa entre BAE e IMC ($p = 1,00$). No existe relación entre la efectividad del bloqueo anestésico del nervio mandibular y el índice de masa corporal en niños.

PALABRAS CLAVE: anestésico local, índice de masa corporal, niños, nervio mandibular.

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