Prevalence and risk factors of failed mandibular anesthesia following simple tooth extraction: an epidemiological study

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ABSTRACT

Background: The mandibular nerve block is frequently used in dentistry, however, it can fail even in the hands of experienced physicians and this can cause distress for patients and dentists. While the prevalence of failed mandibular nerve block is known among Caucasians and Asians, not much is known about the occurrence in Africans.

Objective: To determine the prevalence and risk factors of failed mandibular nerve blocks among dental patients that had simple tooth extraction at a teaching hospital in Nigeria.

Methods: A retrospective study conducted at the Department of Oral and Maxillofacial Surgery, University of Benin Teaching Hospital, Benin City, Edo state, Nigeria Case notes of all patients that presented for simple teeth extraction from July 2010 to August 2020 were retrieved. Collected data were age of patient, gender of patients, religion, place of residence, level of education, marital status, occupation, experience of operator, side of operation, teeth removed, failed mandibular anesthesia and type of alternative method. Chi-square test and binary logistic regression were used for data analysis. A p-value less than 0.05 was considered statistically significant.

Results: Total patients studied were 107 with age range from 19 to 63 years. The mean age and standard deviation were 47.2 ± 4.78 years. There were fewer males than females; male to female ratio was 1:1.5. The prevalence of mandibular nerve block failure was 39.3%. The age ($p<0.001$) and level of operator ($p=0.03$) were significantly associated with the prevalence mandibular nerve block failure. In the multivariate analysis, both age of patients ($p = 0.02$) and level of operator ($p< 0.001$) were associated with mandibular nerve block failure.

Conclusion: Prevalence of mandibular nerve block failure was 39.3% . The risk factors for the prevalence were age of patients and level of the operators. Our finding could indicate high rate of mandibular nerve block failure in this Nigerian population. Larger studies with greater statistical power are required to further elucidate on this subject.

Keywords: Epidemiological study, mandibular, nerve, block, failure, prevalence

INTRODUCTION

Simple tooth extraction is the removal of teeth without flap formation and bone removal with either dental forceps or dental elevators or both[1]. It is the most widely performed dental procedure by students, general dentist, resident doctors and oral surgeons[2,3].

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Successful mandibular nerve block is essential for pain-free simple tooth extraction because failed anesthesia is distressing to both the patient and the clinicians.

Mandibular nerve block also known as inferior nerve block or Halsted technique is used to anesthetize the inferior alveolar, lingual as well as the long buccal nerves. In 1884, Halsted and Hall pioneered the practice of mandibular nerve block by injecting a cocaine solution into the region of the mandibular foramen[4]. Till date, this technique remains the most frequently used in dentistry and most taught to dental students worldwide. However, the failure rates can be substantial, reaching 15 to 20%, and often cannot be overcome with a repeat of mandibular nerve block[5,6]. Technical errors, pathological processes (namely, trismus, infection, inflammation), and psychological causes such as fear, anxiety and apprehension[7] are reported to be the cause failure of mandibular nerve block. Poor technique is the most common reason for failure of mandibular nerve anesthesia[8]. Specifically, poor technique can be related to inadequate mouth opening, incorrect needle placement or failure to give enough time for the anesthesia to work. Malamed has recommended waiting time 3 to 5 minutes after injection before starting procedure[9]. Other factors that can result in failure include anatomical variations, concentration of adrenalin, quantity and expiration of the local anesthetic agents[10,11]. Several studies have reported that a single cartridge of 1.8ml of 2% lidocaine with 1:80:000 adrenaline is sufficient to have a profound anesthesia of the mandibular nerve and this achieved anesthesia is enough to perform simple extraction of mandibular teeth[12-14].

Even for the most experienced dental practitioners, consistent, profound mandibular anesthesia remains difficult to achieve 100 percent of the time. This can be stressful for both dentist and patient and is often disruptive to a busy office schedule. All too often, dental procedures are performed when local anesthesia is incomplete and there is some degree of patient discomfort compromising both the quality of dental treatment and patient confidence. Many authors have contributed to improve the quality of anesthesia of inferior alveolar nerve, refining and creating new techniques to enhance the success rate of the technique[15-19].

Although there are several studies on prevalence of mandibular nerve block failure in other countries[20-24], there appears to be paucity of similar studies in Nigeria. More so, it appears that the risk factors of mandibular nerve block failure were documented by few studies[23,24]. Therefore, the aim of this study was to determine the prevalence and risk factors of failed mandibular nerve blocks among dental patients that had simple tooth extraction at a teaching hospital in Nigeria.

METHODS

This is cross-sectional retrospective study, conducted in the Department of Oral and Maxillofacial Surgery, University of Benin Teaching Hospital (UBTH), Nigeria, from July 2010 to August 2020. Due to the negligible risk of the study to the participants, it was granted exemption by the Institution Review and Ethical Committee (IREC) of the UBTH.

The case notes of all consecutive patients that presented for simple extraction in the period of study were retrieved. The study inclusion criteria were: patients older than 18 years but less than 65 years, grossly carious mandibular molars that were asymptomatic but unsalvageable, and with previous history of simple extraction and therefore familiar with the procedure. The exclusion criteria of the study were: patients with pulpal lesions, dentoalveolar abscess or facial cellulitis, obesity, medically compromised and those with insufficient information from their case notes.

Collected data were age of patient, gender of patient, religion, place of residence, level of education, marital status, occupation, experience of operator, side of operation, teeth removed, failed mandibular anesthesia and type of alternative method of anesthesia. Failed mandibular anesthesia was defined as absence of numbness five minutes after administration of a single cartridge that contained 1.8ml of 2% lidocaine HCL with vasoconstrictor, epinephrine 1:80,000 (Huons Co., Ltd, Korea) using 27 Gauge needle measuring 35 mm in length (Biodent Co., Ltd, Korea)[14].

Categorical data was summarized as frequency and percentages while the continuous was summarized as ranges, means and standard deviations. In the inferential statistics, Pearson's Chi Square test was used for bivariate analysis while logistic regression was used in the multivariate analysis. The predictors were age, gender, religion, place of residence, level of education, marital status, occupation, level of operator, side of operation, teeth removed while the outcome variable was failed mandibular anesthesia. In the cross-tabulation, the age was dichotomized based on the mean age of the study. Data were analyzed with SPSS version 21 (IBM Inc., Armonk, NY, USA). A P-Value less than 0.05 was considered statistically significant.

RESULTS

One hundred and seven patients met the inclusion criteria of the study. Patient age ranged from 19 to 63 years. The mean age and standard deviation was 47.2 ± 4.78 years. Table 1 presents clinico-demographic characteristic of the patients. There were more females than males with a ratio of 1:1.5(M: F). More than half (55.1%) of the patients were Christians. Of the 107 patients, 66.1% of them were urban dwellers. While 47.7% of the patients had the tertiary level of education, only 5.6% had no formal education. More than half (56.1%) of the individuals were single and most of them were skilled and semi-skilled as regard their occupation (90.7%). Most (34.6%) of the patients were treated by final year dental students. Sixty-eight (63.6%) of the patient had most of their teeth removed on the left side of the mouth. The most extracted teeth were the first molars(57.0 %) while the least (19.6 %) extracted teeth were third molars. The prevalence of failed mandibular local anesthesia was 39.3%. Of the 42 patients with failed anesthesia, repetition of same technique was used to overcome failed anesthesia in more than half (59.5%) of the patients while Vazirani-Akinosi technique was used in just two patients and none had Gow-Gate technique.

Table 2 shows the univariate analysis between study variables and failed mandibular local anesthesia. In the cross-tabulation analysis, only the age ($p < 0.001$) and level of operator ($p=0.03$) were significantly associated with failure of mandibular local anesthesia. Other factors such as gender, religion, place of residence, level of education, marital status, occupation, quadrant of operation, and type of lower molar teeth removed were not associated with mandibular nerve block failure (Table 2). The risk factors of failed mandibular local anesthesia following simple teeth extraction are presented in Table 3. Only the age of patients and level of operator were independent predictors of failed mandibular local anesthesia ($p = 0.02$ and $P < 0.001$ respectively). The students were 5.3 times more likely to encounter failed local anesthesia (Table 3) than the consultants. Compared to the patients less than 47 years, the patients older than 47 years were 1.57 times more likely to have failed mandibular local anesthesia (Table 3).

Table 1: Clinico-demographic characteristics of patients (n=107)

Variables	Category	Frequency(n)	Percentage (%)
Gender	Male	43	40.2
	Female	64	59.8
Religion	Christianity	59	55.1
	Muslim	34	31.8
	Others	14	13.1
Place of residence	Rural	36	33.6
	Urban	71	66.4
Level of education	None	6	5.60
	Primary	13	12.1
	Secondary	37	34.6
	Tertiary	51	47.7
Marital status	Single	60	56.1
	Married	27	25.2
	Widowed	11	10.3
	Divorced	9	8.40
Occupation	Skilled	56	52.4
	Semi-skilled	41	38.3
	Unskilled	10	9.30
	Students	37	34.6
Experience of Operator	House officer	30	28.0
	Junior registrar	20	18.7
	Senior registrar	13	12.1
	Consultant	7	6.60
Side of operation	Left	68	63.6
	Right	39	36.4
Teeth removed	First molar	61	57.0
	Second molar	25	23.4
	Third molar	21	19.6
Failed anesthesia	Yes	42	39.3
	No	65	60.7
Failed anesthesia remedy	Repetition	25	59.5
	Akinosi-Vazirani technique	2	4.70
	Intraligamentery	15	35.8
	Gow-gate technique	0	0.00

Table2. Analysis between study variables and failed anesthesia (n = 107)

		Failed anesthesia		
Variables	**Category**	**Yes (n= 43)**	**No(n=64)**	**p-Value**
Age(years)	≥47	11	25	
	<47	32	39	<0.001
	Male	13	30	
Gender (n (%))	Female	30	34	0.52
	Christian	23	36	
Religion	Muslim	15	19	0.18
	Others	5	9	
	Rural	29	7	
Place of residence	Urban	14	57	0.64
	None	5	1	
Level of education	Primary	10	3	
	Secondary	20	17	0.32
	Tertiary	8	43	
Marital status	Single	26	34	
	Married	9	18	0.73
	Widowed	6	5	
	Divorced	2	7	
Occupation	Skilled	29	27	
	Semi-skilled	12	29	0.31
	Unskilled	2	8	
	Students	19	11	
	House officer	11	26	
Level of operator	Junior registrar	6	14	0.03
	Senior registrar	5	8	
	Consultant	2	5	

Side of operation	Left	30	38	
	Right	13	26	0.94
Teeth removed	First molar	24	30	
	Second molar	10	22	0.27
	Third molar	9	12	

Table 3: Risk factors for failure to obtain local anaesthesia following simple teeth extraction

Risk factors	OR (95%CI)	P-Value
Level of operator		
Students	5.33(0.58-48.9)	<0.001
House officer	3.18(0.33-30.6)	0.09
Junior residents	1.03(0.09-68.7)	0.42
Senior residents	1.09(0.10-12.0)	0.67
Consultants**	-	-
Age(years)		
≥47	1.57(0.01-0.76)	0.02
<47**	-	-

OR, odd ratio; CI, confidence interval; ** reference category for comparison

Table 4: Global prevalence of mandibular nerve block failure

Authors	Year	Country	Study	Study Sample	Prevalence (%)
Kaufman et al	1984	USA	Survey	General dentists	11.0
Weinstein et al	1985	USA	Survey	Patients	14.3
Keetley and Moles	2001	London	Prospective	Patients	8.1
Jehad et al	2013	Jordan	Prospective	Patients	6.40
Alhindi et al	2016	Saudi Arabia	Survey	Students and Intens	14.0
Sanchez et al	2018	Brazil	Prospective	Patients	3.40
Salgotra et al	2020	India	prospective	Patients	38.4
Present study	2022	Nigeria	Retrospective	Patients	39.3

DISCUSSION

In this study, the prevalence of mandibular nerve block failure was 39.3% which is comparable to the 38.4% reported by Salgotra et al[24] in India but and remarkably higher than that reported in previous studies[20-23]. The variation in prevalence between our study and previous studies could be related to methodological differences. The reported global prevalence[20-24] of mandibular nerve block failure varies from 3.40% - 38.4% (Table 4). The first epidemiological study on mandibular nerve block failure was reported in the US by Kaufman et al in 1984 reported a prevalence of 11.0%. From the global epidemiological studies, prevalence of mandibular nerve block failure was lower among the Caucasians and sub-Saharan Africans. There could be several reasons for this racial variation in mandibular nerve block failure. First and most important is anatomical differences in mandibular length and height among the world races[25,26]. Other plausible reasons could be the study design, while previous studies were surveys and prospective studies; our study is retrospective study with the attendant limitations. In former studies, assessment of anesthesia failure was subjective while the assessment was objective in the present study. Variations in sample size and the type of study sample could also be responsible.

The mean age of 47.2 years found in this study is comparable to 38.4 years reported by Keetley and More[23], but greater than that reported in other previous studies[20-22,24] and this variation could be attributable to the sample sizes and study samples. Majority of the patients were below 47 years and similar finding was reported by previous study[21] who reported younger patients compared to their older counterparts. Age was significantly related to prevalence of failed mandibular nerve block in this study. Similar statistical association between failed mandibular nerve block and age of the patients was reported by Jehad et al[22]but differ from studies[23,24] that could not observe association between age and mandibular nerve failure[23,24]. In our study, age was an independent risk factor to the mandibular nerve block failure so that the older the patients the greater the prevalence of mandibular nerve block. This could be related to mandibular age changes.

There was gender predilection with majority of the patients being female and similar findings was reported in previous studies[22-24] It has been reported that females are more medically conscious compared to the males. However, gender was not related to the prevalence of mandibular nerve block failure. Previous studies[22-24] did not find a significant association between gender and failure of mandibular nerve block[21]. In this study, though major failure of mandibular nerve block was performed more on the left side of the jaws, however, it was not associated with the higher prevalence of failure to obtain profound mandibular anesthesia. Previous studies reported similar findings when the authors reported most mandibular nerve block failures on the left quadrant of the lower jaws[21,24].

The experience of operator was associated significantly with the rate of failure of mandibular nerve block failure. This finding is consistent with previous studies[21,23] but inconsistent with that of Salgotra et al[24] who reported no association between operator experience and mandibular nerve block failure. The probable reason for this finding may be related to the level of knowledge of anatomy of the pterygomandibular region and poor technique among the less experience operators.

This study has a number of limitations that need to be taken into consideration when interpreting our results. First of all, the study was retrospective in nature; missing information excluded some medical records from inclusion and analysis thereby introducing some selection bias. Secondly, this is a single centre study; a multicenter study could have increased the sample size.

CONCLUSIONS: Prevalence of mandibular nerve block failure of 39.3% was relatively large. The risk factors for the prevalence were age of patients and level of the operators. Our finding could indicate high rate of mandibular nerve block failure in this Nigerian population. Larger studies with greater statistical power are required to further elucidate on this subject.

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