EFFECT OF RESTORATIVE DENTAL PROCEDURES ON VITAL SIGNS IN CHILDREN

Lanre L. Bello, BDS, MS*, Samia K. Darwish, BDS, MS, Cert. Pedo**

خمسة عشر طفلاً وطفلة يتراوح أعمارهم ما بين خمس إلى تسع سنوات اختيروا بطريقة عشوائية من بين الأطفال المتقدمين للعلاج بجامعة الملك سعود، جميع الأطفال طبيعيين ويتمتعون بصحة جيدة، لم يؤخذ في الاعتبار عند الاختيار ما إذا كان لدى الأطفال تجربة سابقة مع طبيب الأسنان، استخدم جهاز الديناماب ١٨٤٦ أس إكس لقياس ضغط الدم وسرعات نبضات القلب وتركيز الأكسجين في الدم الشرياني.

قبل بدء العلاج أو القياسات أتيحت لكل طفل فرصة خمس دقائق للراحة ليتعود على الجو المحيط به. ثم أحكم رباط قياس الضغط على اليد اليسرى وثبت مشبك قياس نبضات القلب وتركيز الأكسجين على أصبع اليد اليمنى.

أخذت ثلاث قياسات عند كل خطوة مما يأتي:

١ ـ قبل بدء العلاج.
٢ ـ أثناء تطبيق المخدر الموضعي.
٣ ـ عند حقن المخدر الموضعي.
٤ ـ بعد دقيقة من إخراج الحقنة.
٥ ـ عند تطبيق العازل المطاطي.
٦ ـ عند حفر الأسنان.
٧ ـ أثناء وضع الحشوة.
٨ ـ وبعد خمسة دقائق من انتهاء العلاج.

وقد أتيحت دقيقتين بين كل خطوة حتى تعود القراءات إلى نقطة البداية، وحتى لا يكون هناك أي تداخل بين تأثيرات الخطوات المختلفة. أخذ متوسط القراءات وأخضعت النتائج لتحليل إحصائي استخدم فيه تحليل التباين باتجاه واحد.

ونتج عن هذه الدراسة ما يلي:

(أ) لم يكن لعلاج الأسنان بخطواته المختلفة أي تأثير واضح على ضغط الدم أو تركيز الأكسجين في الدم الشرياني لدى الأطفال المشتركين في هذه الدراسة.

(ب) كان هناك تأثيراً واضحاً على سرعة نبضات القلب في جميع الخطوات المختلفة.

The effect of restorative dental treatment on blood pressure, pulse rate and arterial oxygen saturation were investigated in a group of children. No significant change in blood pressure and arterial oxygen saturation was observed in the course of treatment but the pulse rate recorded a significant increase. Routine operative procedures do not affect the blood pressure and oxygen saturation but cause a great increase in the pulse especially during local anesthetic administration, rubber dam application and cavity preparation in unsedated children.

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*Lecturer, Division of Pedodontics Department of Preventive Dental Scicences.

** Assistant Professor and Head, Division of Pedodontics, Department of Preventive Dental Sciences, College of Dentistry King Saud University, P.O. Box 60169, Riyadh, 11545, Saudi Arabia.

Address reprint requests to : Dr. L. L. Bello

Introduction

Fear of dentistry is a common problem in the general population.[1-4] Many individuals have apprehension about dental procedures, so that anxiety is an important feature of dental practice. There is usually pain associated with some dental procedures, hence, the need to use local anesthetic especially during restorative or surgical treatment was considered imperative. Such procedures can be carried out more effectively and efficiently if the child is comfortable and free of pain. The most common method used to reduce pain (injection) results in some discomfort. It is well documented that injection is the most universally feared procedure in dentistry for children.[1] Injection creates apprehension and stress which many young children are unable to cope with resulting in their inappropriate behavior in the dental office. Any stressful situation such as dental treatment, therefore, has the ability to alter physiologic functions like blood pressure, pulse rate and respiratory rate.

Psychological and physical management techniques such as tell-show-do, voice control, hand-over-mouth or hypnosis are used in managing behavior problems related to dental treatment. However, variable success has been recorded with these techniques. In many instances, the pharmacological approach such as premedication or nitrous oxide and oxygen analgesia have been utilized. These agents have the ability to reduce the child's fear and apprehension but, in addition, may lead to suppression of physiologic functions such as respiration, heart rate, gag reflex and ability to maintain a clear airway.[5] Constant monitoring of these functions are essential in order to detect and early treat any emergency situation. A number of studies have been conducted to determine variations in pulse rate and oxygen saturation patterns in sedated children during dental treatment,[6-8] however, only a few has been reported in unsedated children.[5]

The purpose of this study was to evaluate changes in blood pressure, pulse rate and arterial oxygen saturation in pediatric dental patients undergoing routine operative procedures and to develop baseline data for the subsequent study of effect of sedative agents on these vital signs.

Materials and Methods

Fifteen patients, 8 boys and 7 girls ranging in age from 5 to 9 with a mean age of 7 years, were randomly selected from the patient population of the pediatric dental clinic at the King Saud University Dental College. All children were normal and healthy. Previous dental experiences and behavior were not taken into consideration during patient selection. Mandibular block anesthesia was administered using 1.8 ml of 2% lidocaine with 1:80,000 epinephrine. Amalgam restoration procedure was carried out on the primary first or second molar under rubber dam isolation. Vital signs which included blood pressure, pulse rate and arterial oxygen saturation were recorded using Dinamap 1846SX* vital signs monitor with oxytrak pulse oximeter. This equipment automatically monitors both blood pressure and arterial oxygen saturation by non-invasive method. The pulse oximeter functions by placing the pulsating vascular bed of the finger or toe between 2-wavelength red and infrared light source and a detector. Light absorption varies with arterial pulsation, the wavelength of light used and the oxyhemoglobin saturation. Using spectrophotometric analysis, the oximeter determines the ratio of oxygenated (red) hemoglobin to deoxygenated (blue) hemoglobin and displays oxyhemoglobin saturation ($Sa0_2$).[8]

Prior to the operative procedure, each child was seated in the dental chair and allowed five minutesto adjust to the environment. Automatic bloodpressure cuff was applied to the left upper arm and the finger clip of the pulse oximeter to the right forefinger. Baseline readings for pulse rate, bloodpressure and $Sa0_2$ were then taken. The readings were also taken during (a) topical anestheticapplication, (b) injection of local anesthetic, (c) post injection period i.e. one minute after removal of the needle from the tissue, (d) rubber dam application, (e) cavity preparation, (f) filling, (g) post operation - five minutes after the end of the operative procedure. A two-minute interval was allowed between each stage of the procedure so as to minimize a "carry-over" effect. Three readings of each parameter were taken and the average recorded.

* Critikon, Tampa, FL, USA.

The effect of each step of the dental procedures on blood pressure, pulse rate and $Sa0_2$ were analyzed using one-way analysis of variance. Least significance multiple range test was then used to see which steps of the operative procedure made the analysis significant. The level of significance was a p value of < 0.05.

Results

The average values obtained for blood pressure, pulse rate and $Sa0_2$ are shown in Tables 1 and 2. The average change (increase or decrease) in blood pressure, pulse and oxygen saturation from the preoperative baseline for each step of the operative procedure is shown in Table 3.

Table 1. Blood pressure changes during the operative procedure.

	SYSTOLIC		DIASTOLIC	
	Range (mmHg)	Mean ± SE (mmHg)	Range (mmHg)	Mean± SE (mmHg)
Preoperative baseline	92-131	105.8 ± 2.5	40-67	57.4 ± 1.9
Topical	96-132	108.0 ± 2.5	40-67	57.9 ± 1.9
Injection	87-134	113.0 ± 4.3	45-70	59.9 ± 1.8
Post injection	98-137	112.8 ± 3.3	49-71	60.8 ± 2.0
Rubber dam	87-132	108.3 ± 3.6	50-73	59.9 ± 2.0
Cavity preparation	96-136	108.5 ± 3.2	50-69	60.2 ± 1.4
Filling	85-148	106.2 ± 4.3	45-69	57.3 ± 1.7
Post operative	81-148	106.4 ± 3.9	40-69	57.8 ± 1.9

n = 15

Table 2. Pulse rate and oxygen saturation during operative procedure.

	Pulse Rate (beats/min)		SaO_2%	
	Range	Mean ± SE	Range	Mean± SE
Preoperative baseline	83-106	95.8 ± 1.8	92-98	96.5 ± 0.4
Topical	86-109	97.7 ± 2.0	94-99	96.7 ± 0.4
Injection	86-126	103.9 ± 2.9*	93-99	96.1 ± 0.4
Post injection	86-117	104.3 ± 2.3*	93-99	95.9 ± 0.5
Rubber dam	86-121	101.5 ± 2.7*	93-98	95.7 ± 0.4
Cavity preparation	85-117	98.4 ± 2.4*	93-98	95.9 ± 0.4
Filling	84-108	96.3 ± 2.0	94-98	96.3 ± 0.4
Post operative	82-108	95.5 ± 1.8	95-99	96.7 ± 0.3

n = 15

* Statistcs : One way ANOVA and least signifcant multiple range test P < 0.05 compared with baseline values. All other comparisons not significant P > 0.05.

Table 3. Percentage change in blood pressure, pulse rate and oxygen saturation from the baseline values during the operative procedure.

	Blood pressure		Pulse	SaO_2
	Systolic	Diastolic		
Topical	2.1	0.9	2.0	0.2
Injection	6.8	4.3	8.4	-0.4
Post injection	6.6	5.9	8.8	-0.6
Rubber dam	2.3	2.4	6.0	-0.7
Cavity preparation	2.5	2.6	2.7	-0.6
Filling	-0.4	-0.1	0.5	-0.2
Post operative	0.4	0.4	-0.3	0.2

Negative values indicate decrease below baseline values.

There was a steady increase in both systolic/ diastolic pressure from the preoperative baseline which peaked during injection phase (113.00/ 59.9) and a comparable value during post injection phase (112.8/60.8) following the removal of the needle from the tissue. It then remained above the baseline throughout the operative period. However, when the data was subjected to one-way analysis of variance, no significant difference was found between the average baseline blood pressure and the operative values at a level of significance of p < 0.05.

The pulse rate also showed a similar trend with the injection and post injection phases recording an average of 103.9 + 2.9 and 104.3 ± 2.3 beats/ min., respectively. These values were above the preoperative baseline levels. Thereafter, it decreased gradually to 95.5 ± 1.8 beats/min. during the postoperative period. The increase in pulse rate was significant (p < 0.02). Least significant multiple range test demonstrated a significant change in pulse rate during injection, post injection, rubber dam application and cavity preparation while the rate during topical anesthetic application, filling and postoperative phases were not significant.

For the oxygen saturation, there was no particular trend. However, some insignificant desaturations below the preoperative baseline were observed as shown in Table 3. The maximum decrease occurred during rubber dam application. Figure 1 shows the percentage increase in pulse rate during the operative procedure.

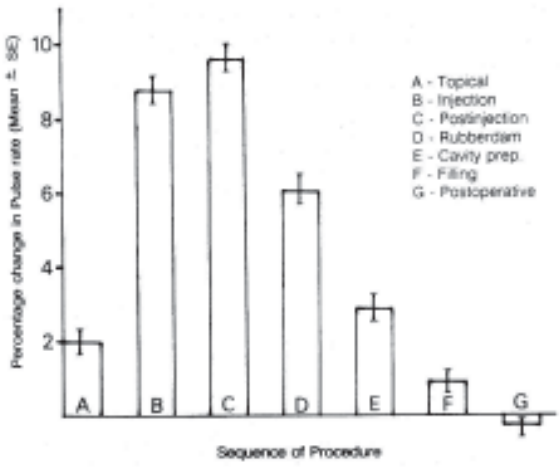

Figure 1. Changes in pulse rate during the operative procedure.

Discussion

Kleinknecht *et al*,[1] in their study of origins and characteristics of fear of dentistry, observed that the most important factors are injection and the sensation of the drill. Halstead[4] also reported an increase in arterial pressure in a group of children during dental visit.

In this study, it was observed that administration of local anesthetic caused the greatest increase (6.8%) in blood pressure. From then, a more rapid decline occurred until the postoperative period when the baseline level was reached. While reviewing the past dental history of the subjects, it was noted that 80% (12 out of 15) had previous dental experience which involved the use of local anesthetic which is a fear-eliciting stimulus.

Simpson *et al*[9] and Myers *et al*[10] reported an increase in pulse rate in a group of children undergoing dental treatment. They attributed this increase to anxiety, fear and or excitement. Similarly in this study, a dramatic increase in pulse (8.4%) during injection with a comparable increase (8.8%) during the post injection period was observed. The largest increase in pulse rate recorded during the post injection period supported the observation of Poiset *et al*.[5] However, they observed a relatively iower increase in pulse rateduringthe injection phase. Reason sfor this difference were not clear. Possible explanations for this difference include different population group, previous dental experience of the subjects, or differences in method of recording the observations. While an automatic meter was used in this study, in which all readings appeared as digital readouts, Poiset *et al*[5] calculated their data from an area under the curve obtained on a pin chart recorder. The decline in pulse rate especially after rubber dam application until the end of the procedure was also similar to the observations of Poiset *et al*.[5]

The pulse is more sensitive to sympatho-adrenal outflow and the change is immediate and more predictable whereas the blood pressure is a reflection of cardiac output, peripheral vascular resistance, blood volume, arterial elasticity and other hemodynamic variables.[11] The unpredictable interplay of these factors could contribute to the differences observed in the significance of change between the blood pressure and pulse.

Although there was no significant change in arterial oxygen saturation throughout the operative procedure, some slight desaturation below the preoperative level was recorded. This was noted to be recorded due to inadvertent flexure of the neck during manipulations in theoral cavity which might have restricted the airway. Whenever the neck was extended the fall in oxygen saturation reversed. Similar observations were reported by other investigators.[5,6,8] This observation lends support to the belief that development of hypoxemia in pediatric dental patients is almost certainly subtle and insidious than most practitioners realize. If such desaturation could occur in unsedated patients during routine dental treatment, then it is very essential that particular attention be paid to the airway and blood oxygenation in patients under sedation.

Conclusion

On the basis of the blood pressure pulse rate and arterial oxygen saturation data provided by the monitoring equipment, it may be concluded that both systolic and diastolic pressures do not change significantly in unsedated children undergoing routine dental treatment. There is a significant increase in pulse rate especially during injection, immediately after injection, during rubber dam application and cavity preparation. The arterial oxygen saturation is not significantly affected by routine dental procedures in unsedated children.

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