

Isolated atrial fibrillation (IAF) after local anaesthesia with epinephrine in an anxious dental patient

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IN BRIEF

- Dentists must be aware that cardiac arrhythmias are not uncommon in dental practice and depend on many factors.
- Careful preoperative patient evaluation represents the best prevention of medical emergencies in the dental practice.
- Since stress is a possible cause of cardiovascular complications, this article highlights the need for peri-operative anxiety assessment and treatment in all dental patients.

Cardiac arrhythmias are not uncommon in dental practice, depending on many factors, including patient features, dental treatment and drugs administered. We describe a case of isolated atrial fibrillation (IAF) developed, in a young patient, soon after a supraperiosteal injection. The patient was admitted to hospital and recovered spontaneously. Since stress is a possible cause of IAF, this may have been triggered by endogenous and/or exogenous epinephrine. We highlight the need for careful preoperative evaluation, including anxiety assessment and treatment in all dental patients.

INTRODUCTION

Cardiac arrhythmias during oral surgery are reported by some authors.¹⁻⁸ In the Borkin *et al.*¹ experience, incidence of arrhythmias was around 16% during third molar surgery, performed under local anaesthesia (LA). Painful stimuli during oral surgery performed under light general anaesthesia may cause transient arrhythmias and many factors are involved in the development of arrhythmias in this setting, such as atropine, hypoxia, hypercapnia and halogenated gases.³⁻⁸ Transient arrhythmias following LA with epinephrine have been also described.^{8,9} We report herein a case of 'isolated atrial fibrillation' (IAF) that occurred, immediately after administration of LA with epinephrine, in a young healthy patient.

CASE REPORT

The patient was a 19-year-old male, a heavy smoker and former basketball player, weighting 90 kg and with ASA I physical status, affected by bilateral pulpitis of the upper first premolars. He was previously treated uneventfully under LA by the same dentist. Preoperative physical evaluation was negative. An anxiety evaluation was not performed. At 6.30 pm, bilateral supraperiosteal infiltration with 1.8 ml of 2% mepivacaine and 1:100,000 epinephrine was performed on each upper premolars. The first injection, on the right side, achieved evident clinical effects; the second one, on the left side, was made in two steps because of the paucity of clinical signs of local anaesthesia. After the second bolus on this side, the patient reported for a few minutes lightheadness, lower limb paraesthesia, hearing disturbances, abdominal discomfort and palpitations; arterial blood pressure was in the normal range and radial pulse was fast and irregular. Surgery was cancelled and the patient was referred to the hospital for further investigations. At 8.30 pm the patient was checked at the emergency department: he was fully alert, slightly anxious and all symptoms had disappeared. LA was still present on the right side only. Electrocardiogram (ECG) showed high-rate atrial fibrillation, unsuccessfully treated with two intravenous

administrations of 70 mg propafenone. All other results from investigations performed were in the normal range. Oral diazepam, 5 mg, was administered, and the patient was monitored until the following morning when, at 10.25 am, IAF resolved spontaneously with restoration of a sinus rhythm. Because dental pain persisted, the patient was referred to the University Dental Clinic for treatment. According to the University of Southern California School of Dentistry protocol,¹⁰ the patient evaluation consisted in the application of preoperative Corah Dental Anxiety Scale¹¹ (CDAS) and 10 cm Visual Analogue Scale (VAS) for anxiety determination, pre and postoperative Newman test¹² for psychophysical performance assessment and American Society of Anesthesiologists (ASA) clinical physical status classification for determination of the perioperative risk class, as reported in Table 1.

According to the stress reducing protocol already described elsewhere by our group,¹³ the patient's management was as follows:

- a) Premedication with oral chlor-demethyldiazepam 2 mg
- b) Monitoring with ECG, non invasive blood pressure, pulse oximetry, bispectral index score (BIS)
- c) Intravenous conscious sedation performed by titration of diazepam and midazolam (total dose 6 and 2 mg

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respectively) until total subjective tranquillity was reported by the patient

- d) Topical anaesthesia with EMLA cream, followed by supraperiosteal infiltration with two cartridges of 2% mepivacaine and 1:100,000 epinephrine; aspiration was performed before and during local anaesthetic administration.

Dental treatment was effective and uneventful; the following day the patient underwent Holter monitoring and echocardiography before being discharged. Holter monitor keeps a record of the heart rhythm, typically over a 24-hour period, while the patient keeps a diary recording his/her activities and the symptoms s/he may feel. The Holter monitor is useful for identifying disturbances which are sporadic and which are not readily identified with the usual resting ECG. In our patient Holter monitoring was normal, while echocardiogram showed minimal biventricular dilation associated to slight left ventricular hypertrophy, interpreted as a physiological consequence of past sport activity and present manual labour.

DISCUSSION

Atrial fibrillation (AF) is common in patients with congenital and acquired cardiomyopathies, congestive heart failure, hypertension, chronic lung disease or thyrotoxicosis. Factors which can precipitate AF in healthy patients include fever, emotional stress, heavy exertion, acute hypoxia or hypercarbia, metabolic derangements and drugs. Possible triggers of arrhythmia in dentistry are trigeminal nerve reflex, stress from pain and anxiety, vasoconstrictors, hypoxia and hypercapnia. In dental patients, anxiety, pain, endogenous and exogenous epinephrine may contribute to the development of arrhythmias. Pain, anxiety, and fear are potent triggers for the so called 'fight or flight response' with activation of the sympathoadrenal system, leading to release of epinephrine and norepinephrine in amounts that enhance heart excitability. Both endogenous and exogenous epinephrine exert potent β effects on heart, increasing the myocardial contractility

Table 1 Preoperative patient clinical features

Age/sex	19 years/male
Body weight/height	90 kg/180 cm
CDAS	12
VAS	5,2 cm
NIBP	122/76 mmHg
ECG	Sinus rhythm, 72 bpm
SpO ₂ (room air)	99%
BIS during sedation	86 - 92
ASA class	II*

ASA: American Society of Anaesthesiologists; BIS: Bispectral Index; CDAS: Corah Dental Anxiety Scale; ECG: electrocardiogram; SpO₂: peripheral saturation of haemoglobin; NIBP: non invasive blood pressure; VAS: Visual Analogue Scale; bpm: beats per minute; ASA II* class because a high anxiety level.

(inotropic effect), the heart rate (chronotropic effect), the atrio-ventricular nodal conduction (dromotropic effect) and the response of myocardial muscle to various stimuli (batmotropic effect).

The case reported presents some distinctive features:

- the patient was an ASA I young man with past intense sport activity and present manual work; the past medical history was negative for important diseases
- the patient's anxiety level was not assessed before the first dental treatment; therefore, neither iatrogenic nor pharmacological anxiolysis was performed. Moreover, at the evaluation before the second dental treatment CDAS indicated a marked anxiety for dental treatment
- a close temporal link between LA, onset of symptoms and onset of IAF is evident
- IAF was unresponsive to propofol while recovered spontaneously on the following day
- the investigations performed excluded both cardiac and systemic diseases as possible causes
- the second dental treatment, performed under conscious sedation and monitoring, was successful and uneventful (*res ipsa loquitur*).

Ventricular hypertrophy may be associated with IAF, but only rarely in healthy people aged less than 20 years.^{14,15} IAF may be triggered in the young by

stressful and prolonged physical activity mainly in a frame of increased vagal tone with bradycardia.^{15,16} In this subject, IAF was diagnosed, mainly based on lack of systemic diseases predisposing to arrhythmias.¹⁴⁻¹⁸ IAF may be triggered by several factors, such as hypoglycaemia, stress, nicotine, caffeine, alcohol or other drugs. Coumel¹⁹ has also described a vagal form, occurring more often in men at night, and an adrenergic form more frequent in women, triggered by emotional stress. Other authors^{20,21} have demonstrated a progressive increase of adrenergic tone in the 30 minutes before the onset of IAF; this results may indicate that the earlier increase of adrenergic tone is followed by a vagal tone predominance, immediately before the onset of IAF. After the second LA administration the patient experienced nothing more than a limited perception of anaesthesia, suggesting that injection into an infraorbital vessel might have occurred. The symptoms appeared after a total dose of 72 mg mepivacaine and 36 mcg epinephrine. According to literature, the infraorbital LA administration has cardiological complications in less than 0.7% of cases.²² We want to stress here, that aspiration always must be carried out before depositing a volume of local anaesthetic, this manoeuvre dramatically minimises the possibility of an intravascular injection. Tolas *et al.*⁹ showed triplication of circulating epinephrine after upper maxillary infiltration with 1.8 ml of 2% lidocaine and epinephrine 1:100,000, whereas Davenport *et al.*²³ described a peak of circulating epinephrine two minutes after administration of the same local anaesthetic. The circulating levels of epinephrine that are achievable after administration of 1.8 ml of local anaesthetic with epinephrine 1:100,000 can yield only minor changes of heart rate and blood pressure.^{9,24} Faraco *et al.*²⁵ and Dionne *et al.*²⁶ have observed a rise of heart rate in patients undergoing dental treatment by 4-6% and 19-30% respectively. These studies support the general belief that, although LA with epinephrine cannot be the only cause of tachyarrhythmias, many different factors may together cause the development of IAF, as probably in this case. The percentage incidence of IAF

following administration of LA containing epinephrine for general dental procedures, not including oral surgery, is not available from literature, but seems to be extremely low.^{1,27}

Some authors^{26,28-32} have demonstrated that the endogenous release of catecholamines increases 20 to 40 times under stress, including anxiety. In particular, F. L. Liau *et al.*²⁸ showed that CDAS is a useful tool for estimating the impact of anxiety on the heart rate during LA delivery in young patients undergoing tooth extraction. Younger patients were more likely to have high anxiety levels, and younger patients with high anxiety were more likely to report a traumatic dental history. High anxiety, younger age, and traumatic dental history were correlated with greater increases in heart rate during LA for tooth extraction. On the other hand, it is well known that anxiety is a very common finding among dental patients. In our case, previous dental pain due to bilateral pulpitis, anxiety due to expectation of dental procedure, and repeated epinephrine injections may have been the concomitant triggers for adrenergic system activation with an excess of endogenous and exogenous epinephrine. This could have triggered the cardiac alterations finally leading to IAF. It is also likely that early tachycardia, a warning signal of electric cardiac alterations caused by sympathetic overreaction, has been missed because of lack of patient monitoring. In this patient a high anxiety level was reported by the preoperative CDAS and VAS values; consequently oral chloridemethyldiazepam was administered as premedication, diazepam and midazolam were titrated intravenously to blunt the stress response. According to our stress reducing protocol¹³ chloridemethyldiazepam and diazepam were used for anxiolysis and midazolam was added to obtain sedation and amnesia.³³ BIS represents a complex parameter based on electroencephalograph signal processing algorithms that may provide an objective, clinically useful tool to

assess sedation depth. We have used the BIS monitoring because midazolam is endowed with sedative effects which may compromise the state of consciousness of the patient and be incompatible with the definition of conscious sedation in dentistry.³⁴ Clinical evidence underlines that preoperative patient evaluation, intraoperative anxiolysis and monitoring are necessary in dentistry, not only in those patients who are medically compromised, uncooperative or require prolonged and invasive dental procedures, but also in apparently healthy anxious patients. In this setting the recent news from UK,³⁵ considered the cradle and cornerstone of modern dental sedation in Europe, concern all of us because this may produce more difficulties to get the benefits of sedation for dental patients also in other European countries.

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