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Does Cocaine Still Have a Role in Nasal Surgery?

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Abstract

Endonasal surgery is already very common and its importance is increasing. Successful anaesthesia in endonasal sinus surgery is of critical importance for the success of the procedure and many surgeons prefer to use cocaine for this purpose. However, there is a great body of evidence that suggests that use of cocaine, even in experienced hands, can cause rapid, unexpected and severe toxic reactions. Therefore, its use in endonasal surgery can no longer be recommended, especially since better tolerated alternatives are available for topical and infiltration anaesthesia. These alternatives include lidocaine (lignocaine) and tetracaine (pantocaine) in combination with epinephrine (adrenaline), naphazoline or oxymetazoline.

1. Anaesthesia During Endonasal Surgical Procedures

Endonasal surgical procedures are among the most common procedures performed by the otolaryngologist. They include a wide range of different operations such as septoplasty, rhinoseptoplasty, conchal surgery and paranasal sinus surgery.

Some of these procedures are mainly performed under local or regional anaesthesia, others under general anaesthesia and in some procedures the type of anaesthesia used depends on the surgical technique or instrument that is used, or on the skill and experience of the surgeon.

Successful anaesthesia in endonasal sinus surgery is of critical importance for patient comfort, to reduce bleeding and for safety during the procedure.

Topical anaesthetics and/or vasoconstrictors are used in most intranasal procedures, either in addition to general anaesthesia or alone. The combination of cocaine and epinephrine (adrenaline) applied as a paste is widely used.[1,2]

Other commonly used agents include lidocaine (lignocaine), tetracaine (pantocaine) in combination with epinephrine, naphazoline or oxymetazoline.

In section 2, the history of endonasal sinus surgery is described to demonstrate how surgical needs influence the type of anaesthesia. Modern methods of performing sinus surgery have rapidly taken over from other surgical techniques as a result of the availability of appropriate optical tools such as operating microscopes and endoscopes.

2. Endonasal Sinus Surgery

As classically taught, endoscopic sinus surgery is most safely performed under local anaesthesia.

If properly performed, local anaesthesia provides good surgical conditions, minimising dis-

comfort to the patient. Additionally, it is argued that local anaesthesia is superior to general anaesthesia with regard to the safety of the procedure.

Endonasal surgical procedures were employed by Hajek[3] and Halle[4] in surgery on the ethmoidal cell system at the beginning of this century. However, the improvement and refinement of surgical procedures, which is still ongoing, was only made possible by the introduction of optical aids. According to Luckhapt et al.,[5] Bozzini and Nitze laid the foundations for the start of optical endoscopy, the next major step was the development of rod lens optics by Hopkins.[6] This type of optical endoscopy was used by Messerklinger[7,8] to gain basic knowledge of the pathophysiology of the nose and the sinuses and to develop his approach to functional sinus surgery.

Modern endonasal surgical procedures use optical instruments to improve the surgeon's depth perception of the surgical site. Thus, modern sinus surgery is either endoscopic[7-20] or microscopic surgery.[21-25] Areas at risk for potential surgical complications, such as the skull base in the anterior and posterior ethmoid, especially in the area of the anterior ethmoidal nerve, the orbit and structures such as the optic nerve and carotid artery, have markedly increased pain sensitivity. Under local anaesthesia, the patient is able to indicate to the surgeon, when pain is increased, thereby providing additional anatomical guidance to the surgeon.

An additional benefit of local anaesthesia is that by using this technique, endoscopic sinus surgery can be performed as an outpatient-procedure.

3. Technique for Local Anaesthesia for Functional Endoscopic Sinus Surgery

Cotton pieces of about 1 × 1cm secured by a ligature tail are placed into a metal dish containing the anaesthetic mixture, soaked, and wrung out after removal in order to avoid superfluous solution running into the nasopharynx and being absorbed or swallowed. These pledgets are then introduced with bayonet forceps into the nasal cavity beginning at the entrance of the middle meatus. Further pledgets are placed at the end of the middle turbinate, the sphenoethmoidal areas, the middle meatus and then anteriorly between the septum and middle turbinate. Special care should be taken that the lateral nasal wall at the attachment of the middle turbinate, the uncinate process and the agger nasi region are all in contact with the solution.

The pledgets are left in place for at least 10 minutes and then removed from the side to be operated upon first.

Infiltration anaesthesia is then performed along the uncinate process and the insertion of the middle turbinate using a special septal needle. The solution is injected using endoscopic control under the mucosa until blanching indicates sufficient injection.

Only rarely are amounts of more than 1 to 1.5ml solution required for each side. One to 2 minutes after injection, surgery can begin. If the patient reports pain during the procedure, soaked pledgets can be used again to pack the respective area loosely.

4. Agents Used for Topical Anaesthesia

4.1 Cocaine

Cocaine was the first local anaesthetic in modern medicine. It is still widely used, particularly for nasal surgery. This is due to its unique property to provide fast and profound anaesthesia together with vasoconstriction and shrinkage of swollen mucosas. However, the extensive vascular supply of the nasal mucosa can lead to rapid and massive systemic absorption of cocaine resulting in severe cardiovascular and central nervous system reactions.[26-29]

Cocaine was used for centuries by the Incas for religious and medical purposes.[30] When the Spaniards went to Peru, they used the drug's unique properties to increase stamina and to alleviate hunger and thirst when they forced the natives to work in silver mines. Koller and Freud introduced cocaine into ophthalmological surgery in 1884, and shortly thereafter, Hall used it for dental operations.[30,31]

Cocaine is a complex alkaloid, benzoylmethylecgonine and an ester of benzoic acid. It belongs to

the tropane family of natural alkaloids. Other members of the family include scopolamine and atropine. Cocaine is obtained from the leaves of the coca shrub *Erythroxylon coca*; 100g of dried leaves will yield approximately 1.8g cocaine. It provides local vasoconstriction by inhibiting norepinephrine (noradrenaline) reuptake which can also result in tachycardia, hypertension, systemic vasoconstriction, mydriasis and diaphoresis. Myocardial workload is increased and oxygen supply decreased due to reduced coronary blood flow with a subsequent risk of coronary infarction.[26,32] Patients receiving topical intranasal cocaine 2 mg/kg during cardiac catheterisation showed decreased coronary blood flow and a reduction in the diameter of the left coronary artery (up to 12%), accompanied by increased heart rate and arterial pressure.[33]

Dopamine reuptake blockade results in prominent effects of cocaine on CNS function. These include euphoria, anorexia, stereotypy and hyperactivity. These central dopaminergic effects are believed to be responsible for the cocaine 'high' and the strong reinforcing properties of the drug.

Topical intranasal cocaine 1.5 mg/kg is rapidly absorbed, with peak plasma concentrations occurring 30 to 60 minutes after application. Topical cocaine is detectable on nasal mucosa as long as 3 hours after application, and for up to 6 hours in the plasma.[27] Peak plasma concentration is proportional to the dose administered.[28] As absorption is also proportional to blood flow, reduced tissue perfusion decreases vascular absorption. Vasoconstriction may be a mechanism that limits absorption of cocaine and different degrees of vasoconstriction could explain interindividual variability in rate of absorption.[28]

The biological half-life of cocaine is 0.5 to 1.5 hours. It is hydrolysed nonenzymatically to benzoylecgonine and by plasma and liver cholinesterases to methylecgonine; these substances have biological half-lives of approximately 6 and 4 hours, respectively.[34,35] To a lesser extent, oxidative metabolism occurs in the liver and of the metabolites produced, norcocaine is the only one that is pharmacologically active.[35,36]

Today, cocaine is used almost exclusively as a topical anaesthetic of the upper respiratory tract. Effective topical anaesthesia requires high concentrations. Solutions of 2 to 10% strength are commonly used. Some authors[10,37,38] recommend powdered cocaine, or cocaine flakes, that are placed with nasal applicators. This cocaine is either 10%[9,39] or 5%[10,38] and approximately 150 to 200mg of cocaine is used. Higher concentrated solutions and pastes (up to 25%) are sometimes used because of their rapid onset and long-lasting duration of action. The topical effect of cocaine, when applied to the tongue, begins within 4 minutes and lasts about 10 minutes; a 20% solution, used with epinephrine, has a latency of only 20 seconds until onset of effect and lasts nearly an hour.[40]

Epinephrine is added to cocaine to delay systemic absorption and to improve haemostasis, but systemic epinephrine enhances the sympathomimetic effects of cocaine leading to possible serious dysrhythmias.[1,41,42] Although epinephrine effectively reduces cocaine absorption, its effect is inconsistent. Lips et al.[43] showed that adding epinephrine to 4% cocaine solution for nasal surgery significantly decreased mucosal absorption and peak blood concentrations. This effect was not detectable when epinephrine was added to 25% paste, resulting in extremely high cocaine blood concentrations. Bromley and Hayward[29] found that epinephrine reduced nasal absorption of cocaine following application of 1% cocaine bicarbonate solution in most patients; however, 3 out of 15 patients developed bradycardia and 2 of these had extremely high plasma concentrations.

General anaesthesia seems to increase the risk of cocaine toxicity. When applied to reduce stress from laryngoscopy during thiopental sodium induction, cocaine produced severe ventricular dysrhythmias which were not seen when lidocaine was applied instead.[44] After topical nasal cocaine was applied, atrial and ventricular premature beats were seen in patients receiving halothane anaesthesia. Nicholson and Rogers[1] reported ventricular

fibrillation in 2 children during halothane anaesthesia after use of topical nasal cocaine (25%) and epinephrine (0.18%) paste, and 1 case of tachycardia, multifocal ventricular ectopic beats, sustained hypertension and ST segment depression after cocaine and epinephrine paste during propofol anaesthesia.

Although there are some studies showing that cocaine during general anaesthesia has no proarrhythmogenic properties,[45] no sympathetic activity,[46] and does not induce haemodynamic disturbances even in combination with epinephrine,[43] we do not encourage the use of cocaine for nasal surgery because of its potential to cause rapid and severe adverse reactions.

4.2 Alternatives to Cocaine

In general, all commonly used local anaesthetics can be use in endonasal surgery. They can be grouped into amides (lidocaine, prilocaine, mepivacaine, bupivacaine and etidocaine) and esters (tetracaine and procaine). A disadvantage of the esters is their higher potential to cause allergic reactions, possibly due to the formation of the metabolite para-aminobenzoic acid. However, no hard data exists on the incidence of such reactions following endonasal application and, in particular, tetracaine is widely used and appears to be well tolerated.[14] Therefore, as alternatives to cocaine, lidocaine (2 to 4%), mepivacaine (2 to 4%), bupivacaine (0.5%) and tetracaine (2 to 4%) can be recommended, if spray application is desired.

For infiltration anaesthesia, lidocaine (1%), mepivacaine (1%), bupivacaine (0.5%) and procaine (1%) can be used.

The preoperative situation in endonasal surgery commonly requires anaesthesia and vasoconstriction properties and recommendations are given in the literature.

For topical anaesthesia and vasoconstriction, a mixture of 2% tetracaine (4 parts) and 1 : 1000 epinephrine (1 part) is recommended.[14] Tetracaine[14] and lidocaine spray with naphazoline[23] can also be used.

For infiltration anaesthesia, most groups use 1% lidocaine with 1 : 100 000 epinephrine[10,37,38] or 1 : 200 000 epinephrine[14] in volumes of 1ml up to 4ml per side.

5. Conclusion

Cocaine is unique, being the only drug that produces local anaesthesia and vasoconstriction. Vasoconstriction, as well as sympathomimetic adverse effects, are caused by inhibition of norepinephrine reuptake. Dopamine reuptake blockade has prominent effects on CNS function. Although the incidence of adverse reactions is low, those that have been described have been rapid, unexpected and severe. The role of added epinephrine in enhancing or diminishing cocaine toxicity is not clear, nor that of endogenous catecholamines.

Since better tolerated alternatives, such as a mixture of 2% tetracaine and 1 : 1000 epinephrine or tetracaine and lidocaine spray with naphazoline are available for topical anaesthesia, the use of cocaine in endonasal surgery should be abandoned.

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