100 Years of Local Anesthesia in Dental Medicine

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100 years ago, local anesthesia made its debut in dental medicine. Dental medicine was fundamentally changed unlike any other medical discipline. Local anesthesia is the most frequently used form of pain relief in dental medicine.

Since the discovery of the first tolerable local anesthetic, other optimized preparations, injection methods and syringe systems were developed. Perfected local anesthetics and injection systems are available for every type of application for performing dental and dental-surgical procedures. Modern production facilities and established quality assurance systems ensure reliable availability and consistently high quality (Figs. 1, 2).

History

The substance procaine, the first effective and tolerably local anesthetic, was synthesized in 1895. One year earlier, adrenalin, which is added to local anesthetics as a vasoconstrictor, was first successfully synthesized. By adding such vasoconstrictors, removal of the local anesthetic is delayed, whereby the duration of local anesthesia such as in the case of lidocain, for example, may be doubled.

Local Anesthetics in Dental Medicine

The requirements imposed on a clinically usable local anesthetic include water solubility, sterilisability and tissue compatibility. In order to prevent toxic effects, a local anesthetic should be inactivated as rapidly as possible after absorption.

Today, the local anesthetics used clinically are divided into esters and acid amides based on their chemical structure. Because of their higher risk of hypersensitivity, the local anesthetics of the ester group should be generally avoided. Of this group, tetracaine and benzocaine have an area of indication as topical anesthetics.

Only certain local anesthetics are used for local anesthesia in dental medicine and are used routinely. These include lidocain, mepivacaine and articaine, for example. These substances belong to the amide group. They exhibit very low allergic potential. The occasionally observed intolerance reactions are caused by the added preservatives (such as methylparaben) and/or excipients (eg, sulfites) (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Articaine</th>
<th>Lidocaine</th>
<th>Mepivacaine</th>
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</thead>
<tbody>
<tr>
<td>Relative toxicity (reference: procaine = 1)</td>
<td>1.5</td>
<td>2</td>
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<tr>
<td>Half-life (minutes)</td>
<td>2 min.</td>
<td>96 min.</td>
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<tr>
<td>Maximum Dose (adult)</td>
<td>500 mg</td>
<td>500 mg</td>
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<tr>
<td>Average Duration of Action</td>
<td>40–60 min.</td>
<td>60–90 min.</td>
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Lidocain is the most widely used worldwide, and is quite appropriate for spatially expanded treatments. It is used as a 2% solution for infiltration and nerve block anesthesia (eg, Xylonor 2% special, Septodont). It can also be used in topical anesthetics (Xylonor Spray, Septodont) for the skin and mucosa.

Because of its very low vasodilatory activity, Mepivacaine can be used also without vasoconstrictors. This local anesthetic should be considered in patients with contra-indications for the use of adrenalin or sodium disulphate. It is also suitable for inter alia for special at-risk patients such as asthmatics, persons with allergies or cardiovascular-labile patients. Because of the relatively short therapeutic utility time, the 5% solution should be used (eg, Scandonest 3% o.V., Septodont) (Fig. 3).

Articaine is characterised by pronounced local anesthetic activity with low toxicity. The half-life time of 20 minutes is clearly below the times for the other amide local anesthetics. Approximately 90% of all dental anesthetics performed in Germany use this substance. Articaine is used predominantly as a 4% solution (eg, Septanest, Septodont; Ubisten, 3M ESPE; Ultracaine, Sanofi Aventis) (Fig. 4).

Vasoconstrictors

Elimination of synthetic local anesthetics from the site of activity is accelerated due to the fact that in contrast with natural cocaine, they have no vasoconstrictivity but do have vasodilatory activity. This is to minimize the absorption of the local anesthetic. This drawback can be counteracted by use of vasoconstrictors such as adrenalin, noradrenalin or felypressin.

By virtue of the vasoconstrictor, the elimination of the local anesthetic is slowed and consequently there is a lengthening of the therapeutic utility time and the potentiating of the intensity of action. Another effect is the reduction of local perfusion, which can be an advantage in surgical procedures.

The majority of dental local anesthetics contain the adjuvant adrenalin in concentrations of 1:100,000 and 1:200,000. Sulfite is added as an antioxidant in order to stabilize the oxygen-sensitive adrenalin. Here, the corresponding risk of sulfite allergy must be considered. In the majority of cases, the lower adrenalin concentration of 1:200,000 is adequate. Nevertheless, a higher adrenalin concentration is of interest if, in dental-surgical procedures, greater vasoconstriction is desired for a better intraoperative overview.

However, it must be noted that depending on the method of administration, different effects must be expected by virtue of the vasoconstrictor addition. In the case of infiltration anesthesia, the duration and intensity of the local anesthetic increases dose-dependently with increasing adrenalin addition, whereas in nerve block anesthesia the reverse effect must be expected.

Administration & Injection Methods

In the majority of cases, local anesthetics in dental medicine are administered in the form of topical, infiltration or nerve block anesthesia. Special local techniques include intraligamental, intraseptal, intraosseal and intrapulpal anesthesia. In general, cylinder ampoule syringes are used for infiltration and nerve block anesthesia. These make aspiration of the local anesthetic possible before injection, and thus increase the safety of administration.
In addition, easy-break ampoules and, in cases of high use, multi-dose bottles are used. Multi-dose dispensing bottles must, however, contain preservatives, which represents an allergy risk. For persons with allergies, therefore, the use of easy-break or cylinder ampoules is preferred because these usually do not contain preservatives.

Injection should be done slowly (circa 1 ml/30 sec.). In the case of intraligamentary anesthesia, an even slower injection is required. Here, special injection syringes are available that make uniform and reduced pressure injection possible. Recently, electronically controlled injection systems (Anaject, Wand), have become available.

Today, thin disposable needles with a precision bevel, such as the triple lancet bevel (Septject, Septodont), are used as injection needles. Other developments for reducing injection pain are injection needles with a silicon coating for improved sliding characteristics and canulas with a thinner wall thickness for reducing the injection pressure required and a slowing of the flow of the injection solution (Seproject XL, Septodont).

Complications
Most frequently, adverse non-specific systemic effects occur that are caused by the injection itself. In extremely rare cases they require specific treatment and are only transient in nature. Drug-dependent adverse effects such as intoxication or anaphylactic shock are potentially life-threatening.

Intoxication can be triggered by overdosage of the local anesthetic or by vascular injection. The symptoms of intoxication are of the CNS type. Dizziness, tremors, facial twitching, seizures, decrease in pulse and blood pressure, and a respiratory or cardiovascular arrest can also occur.

The first symptoms in anaphylactic shock include reddening and swelling of the injection site followed by pruritis. A generalized release of histamine can cause cardiovascular shock symptoms like an increase in heart rate and a drop in blood pressure. Finally, the result of this can be cardiovascular arrest.

Intoxication and anaphylactic shock require immediate action by the dental team and operational emergency equipment. An essential component of emergency prophylaxis is a careful and regularly updated medical history.