Introduction

Behavioural management of young or handicapped patients is a major challenge to clinicians. Very often, excessive time and efforts have to be made to conduct a dental examination, let alone the delivery of treatment. In the past, different modalities of sedation techniques have been employed to facilitate treatment. The most common drug regimens and techniques are listed in Table 1.

In most published studies, any sedation regimen that allows a procedure to be completed is counted as successful. For instance, with oral Midazolam, a patient who may cry or scream during the procedure and sleep for two hours is considered an equal success as another patient who lies perfectly still under brief Propofol sedation. An ideal sedation procedure should be easy to administer with a wide margin of safety. Rapid onset and recovery with little emergence reactions are other important criteria so as to minimise pre- and post-operative discomfort and reduce patient monitoring time. In addition a smooth and well-controlled sedated patient throughout the treatment procedure will render the process stress-free for the patient, clinician and parents.

Table 1

<table>
<thead>
<tr>
<th>Drug regimen</th>
<th>Dose/route of administration</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Midazolam</td>
<td>0.05-0.15 mg/kg (PO); 0.025-0.05 mg/kg (IV)</td>
<td>Paradoxical reactions are not infrequent</td>
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<tr>
<td>Chloral hydrate</td>
<td>50-100 mg/kg (PO)</td>
<td>Still the most popular drug for oral sedation</td>
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<tr>
<td>Nitrous oxide</td>
<td>70% in 50% oxygen, up to 70% (Inhalation)</td>
<td>Long history of safe use providing moderate sedation for minimally moderately painful procedures</td>
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<tr>
<td>Ketamine</td>
<td>3-4 mg/kg (IM); 1-2 mg/kg (IV)</td>
<td>Effective sedation and analgesia for painful procedures; relatively common nausea and vomiting after procedure; laryngospasm reported</td>
</tr>
<tr>
<td>Propofol</td>
<td>100-200 μg / kg / min (IV)</td>
<td>Ideal agent for non-painful diagnostic procedures; only for use by expert airborne managers with good back-up systems</td>
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</table>

There are certain limitations with different regimens. Paradoxical reactions and prolonged sedation post-operatively are common with oral sedatives such as Midazolam and chloral hydrate. The patient may wake up in the middle of the treatment and compromised procedures may ensue. With inhalation sedation by nitrous oxide, it is difficult to achieve or maintain the desired sedated state if the patient keeps on crying or unco-operative with breathing through the nasal hood. Intravenous induction by Ketamine or Propofol remains a problem because of the difficulty in obtaining vascular access in the awake and frightened child. In view of the above technical and pharmacological limitations, a novel technique for office-based sedation combining inhalation induction by Sevoflurane and intra-venous sedation by Propofol is developed (Picture 1).

1. Pharmacological Considerations

Potent volatile anaesthetic agents are used for induction of anaesthesia to avoid the struggle to get intravenous access before the child is asleep. Sevoflurane is a potent volatile anaesthetic (Minimum Alveolar Concentration in children is 2.49%) with low blood-gas solubility, resulting in fast onset and offset (induction often within one minute). Sevoflurane is therefore ideal for induction before infusion of a total intra-venous anaesthetic (TIVA) such as Propofol to maintain the sedation.

Propofol is a water-immiscible oil which is formulated as an emulsion with a soya oil base to facilitate injection. The elimination half-life of Propofol is estimated to be between 2-24 hours. However, its duration of clinical effect is much shorter because Propofol is rapidly distributed into peripheral tissue, and its effects therefore wear off considerably within even a half hour of injection. This, together with its rapid effect (within minutes of injection) and the moderate amnesia it induces makes it an ideal drug for intravenous sedation.

The combination of an inhalation induction of Sevoflurane, and maintenance of sedation by intravenous infusion of Propofol has made dental treatment possible for most paediatric patients who would otherwise require general anaesthesia in order to undergo the treatment.

2. Patient Selection and Pre-operative Preparation

For pre-operative assessment, the clinician should only select ASA I and II patients and review their medical
history and current medication use. Verbal or written instructions such as fasting guidelines (NPO) must be given to the parents/caretakers of the patients. Informed consent to the sedation and clinical procedures must be signed by the parents/guardian. Pre-operative screening is mandatory to identify contra-indications to the sedation procedures such as known or suspected airway problems, pulmonary disease, severe gastro-oesophageal reflux disease and cardiac disease.

3. Personal and Equipment Requirement
In the administration of intra-venous Propofol, it is suggested that ONLY anaesthetists working in an appropriate environment should practise this technique. Equipment set up must include vaporiser for Sevoflurane induction, positive pressure oxygen for ventilation (Picture 2), computer-controlled infusion pump and monitoring system for oxygen saturation, heart rate, blood pressure, and ventilation (Picture 3). Equipment suitable to provide advanced airway management and advanced life support should be on the premises and available for use. Pharmacological antagonists/boosters and resuscitation medications should also stand by in case of emergency.

4. Clinical Procedures
With the parent holding the child, seated in a suitable chair, the anaesthetist will place the oxygen mask over the patient’s nose and mouth. With a cooperative child, a 50% mixture of nitrous oxide in oxygen can be gradually introduced (coloured reservoir bags can help to bring a sense of “play”) As the child gets used to the induction, Sevoflurane can be gradually introduced. (The child can be encouraged to blow away the nasty smell). After a few more breaths and usually within 10 to 20 seconds, the child is sedated and ready for the intra-venous access. The intra-venous cannula is placed either in the hand or ankle, and connected to the infusion pump with low dead space (usually 1mg/kg body weight) the anaesthetist will titrate the maintenance dosage needed to achieve satisfactory sedation, ranging from 0.3 to 4mg/kg/hour. This technique provides conditions which allow the dental surgeon to complete procedures, without compromising the treatment because of patient movement or a combative reaction. With good co-ordination between the anaesthetist and the clinician, the timing for recovery from sedation, upon completion of treatment can be as short as a few minutes. After the procedure, the patient must be monitored until he/she has met discharge criteria before they leave the clinic, and post-operative instructions must be given to the parents.

5. Safety Tips
During treatment, it is important to maintain a patent airway as the patient breathes by him/herself. Transient oxygen desaturation (under 90% SpO2) can be relieved by placing mouth prop, nasal cannula, head tilt, jaw thrust and avoid compressing the mandible. The airway can be protected by rubber dam and placing the patient in the sniffing position (Picture 4). Irrigation fluid collects in the natural curvature of the pharynx when the neck is extended, and together with the careful use of suction, aspiration of fluid into the patient’s airways can be avoided. To prevent hypothermia during sedation, it is advisable to cover the patient with a blanket. Adequate use of local anaesthesia can keep the level of sedation to the minimal.

Discussion
In order to carry out extensive dental treatment for apprehensive patients that involve surgery, root canal therapy or lengthy restorative procedures, moderate to deep sedation is the level of sedation required to accomplish the task. Deep sedation is defined as the drug induced depression of consciousness when the patient cannot be easily aroused except by pain. The patient has impaired ability to independently maintain airway but cardiovascular function is usually maintained.

For different levels of sedation, the American Dental Association and American Academy of Pediatric Dentistry have listed comprehensive guidelines for monitoring and management of paediatric patients during and after sedation for diagnostic and therapeutic procedures. Clinicians using sedation to deliver treatment to their patients, it is strongly recommended that one should comply with the listed guidelines so that the treatment procedures are carried out under optimal conditions.

Although the incidence of mortality and morbidity associated with paediatric sedation are rare the focus on sedation safety must remain a top priority.

Attention should also be directed towards minimising side effects and toxicity so that the concern of the parents on any potential adverse effect on the patient can be alleviated. In addition, it is envisaged that more research and development on improving patient monitoring system will bring about a better-controlled and more predictable level of sedation. Due to their pharmacological characteristics, Sevoflurane and Propofol offer a very quick onset and offset of sedation. The desired level of sedation can be readily adjusted by changing the infusion rate and dosage making them the drugs of choice.

In Hong Kong, according to the data from Oral Health Survey in 2001, the dmft of 5-year-olds has a mean value of 2.3. Although 51% of these children remain carries free, 24% of children accounted for 78% of teeth affected by decay. In other words, there is a high-risk group of children who are presenting with severe dental problems. In order to deliver comprehensive dental rehabilitation to these children who are too young to cope with treatment, sedation or general anaesthesia (GA) is often needed. Another group that also have indication for dental treatment under sedation is the handicapped or autistic children. Such special needs children are often put on long waiting lists in the hospital GA schedules. Office-based sedation can be a cost-efficient alternative for such patients.
Recent studies comparing costs in providing dental care for special needs patients under sedation versus general anaesthesia found that mean office sedation charges are 20% to 30% of mean hospital GA charges. Hence, office-based, ambulatory sedation and anaesthesia play an integral role in the management of anxiety and pain control of dental patients. It is in the best interest of the public and the profession that access to these cost-effective services be made widely available.

Conclusion

With well-trained clinicians and anaesthetic staff, full equipment set up and following standardised protocol, office-based sedation offers a viable option for such patients whose dental treatment may otherwise be impossible to render.

References