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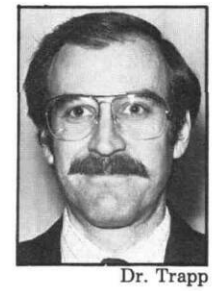
Dr. Trapp

Sedation of children for dental treatment

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Abstract

The sedation of the difficult to manage child with a combination of a narcotic and a phenothiazine or phenothiazine-like drug has proven to be a preferred pharmacologic approach for many dental practitioners. The approach appears to be utilized most frequently by those practitioners limiting their practice to children's dentistry. Sedation with this combination of drugs, known as neuroleptanalgesia, and its historical development is discussed. The pharmacologic alternatives to neuroleptanalgesia are presented. Comments and recommendations are made regarding sedation of the child dental patient.

Dentists who treat children have always encountered a certain fraction of their patients that could not be treated in the routine manner (i.e., local anesthetic and appropriate techniques of behavior modification). Several approaches to patient management have evolved as a result of providing treatment to this group of patients. They include: (1) physical restraint; (2) hypnosis; (3) pharmacologic sedation; and (4) general anesthesia. These approaches to patient management should not be considered alternatives to techniques of behavior modification, but rather supplements to those techniques. The goals, pharmacologic alternatives, and pertinent drug interactions of pharmacologic sedation are presented with related general comments and recommendations.

Goals of Sedation

In any discussion of sedation for the young dental patient, the goals of sedation must be specified. Without goals, it is not possible to establish criteria for the success or failure of any approach to sedation. Hence, a comparison of approaches is not possible. The primary goal is patient safety: therefore this goal avoids general anesthesia. The second goal is restraint of patient movement during treatment. The third goal is establishing a non-negative psychological response to treatment in the patient. The fourth and last goal is that the patient arrive and leave in a state of consciousness that is as close to normal (for that patient) as possible. Any one approach to sedation will not fulfill all four criteria. These goals are ranked in decreasing order of importance (author's ranking). There are other desirable goals, but of lesser importance.

Pharmacologic Alternatives

Pharmacologic alternatives in patient sedation for pediatric dentistry fall into one of four categories: (1) nitrous oxide/oxygen, (2) sedative-hypnotics, (3) phenothiazine and phenothiazine-like drugs, and (4) narcotics. Because the most widely accepted definition of sedation requires a response to command,[1] ketamine, Ketalar® or Ketaject,® cannot strictly be defined as a drug capable of sedation. Thus, this intriguing and powerful agent has not been categorized in the four groups described above and it will be excluded from the following discussion. If the practitioner appreciates how well each drug group or combination of drug groups can satisfy the goals for sedation that have been established, an optimal approach to sedation can be knowledgably selected.

Nitrous oxide/oxygen is one of the safest agents for sedation. However, it has a relatively low potency when administered in the recommended range of 30 to 50% nitrous oxide and 70 to 50% oxygen, respectively. Therefore, physical activity is frequently not well controlled with this agent alone. Although admittedly difficult to assess, the euphoric properties of nitrous oxide/oxygen probably result in a non-negative psychological response in the group of patients that passively undergo their dental treatment. Nitrous oxide/oxygen is unsurpassed in recovery rate.

The group of drugs categorized as sedative-hypnotics is rather large and includes agents such as chloral hydrate (Noctec®), the barbiturates (such as Seconal®), and the benzodiazepines (such as Valium®). The oral administration of these drugs in a responsible manner is considered very safe. However, the benzodiazepines appear to be con-

siderably safer than the other members of this category.

When given by a parenteral route (i.e., other than oral), the drugs in this group can no longer be labelled as very safe due to the easy transition from sedation to general anesthesia. Restraint of physical activity is commonly observed, but large doses may be necessary to eliminate the response to threatening situations and/or painful stimuli. This is more frequently observed with the barbiturates due to a pharmacologic property called antanalgesia. After receiving barbiturates, the patient may be sensitized to painful stimuli and respond more vigorously than he would have if he had not had the drug.[2] The orally administered barbiturates, in large doses, are also potent respiratory depressants.

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Of the group of drugs categorized as phenothiazines and phenothiazine-like agents, only a few have been widely utilized in sedation for dentistry: (1) promethazine, (2) hydroxyzine (Vistaril® or Atarax®) and (3) diphenhydramine (Benadryl®). Each drug in this group shares antihistaminic, antiemetic, antisialogogic, sedative, and respiratory depressant properties. The respiratory depressant properties are usually not clinically significant unless a second drug has been administered.

The phenothiazines and related drugs are very safe when administered orally or intravenously. The subcutaneous use of these drugs has been contraindicated by their manufacturers due to localized tissue toxicity. On the basis of analogous anatomy and clinically significant tissue responses observed subsequent to submucosal injection of these agents, they should be relatively contraindicated by the submucosal route. Restraint of physical activity is minimal with this drug and it does not appear to appreciably alter the postoperative perception of dental treatment. Sedation may be obvious for two to three hours after treatment.

The number of drugs in the narcotic category is large. The drugs useful in pediatric dentistry appear to be limited to fentanyl (Sublimaze®), alphaprodine, and meperidine (Demerol®). The basis for this limitation is that the only major differences in potent parenteral narcotics is their duration of action. These three narcotics provide a range of clinical working times that encompass the vast majority of appointments in pediatric dentistry. Most narcotics are poorly absorbed by the gastrointestinal tract, and they are therefore usually administered parenterally.

The side effect of narcotics that is most frequently responsible for morbidity and mortality is respiratory depression. One must always be concerned with the rate and depth of respirations when a drug from this group is utilized. Agents from this drug group are capable of reducing physical activity, but painful stimuli frequently result in patient movement: potency in this regard is surprisingly unimpressive when the patient is within acceptable respiratory parameters. The modest amount of euphoria narcotics provide may improve the postoperative psychological response to dental treatment. Clinical recovery from fentanyl is substantial at one hour after injection. Clinical recovery from alphaprodine is in the range of one to two hours and recovery from meperidine is on the order of two to three hours.

It is important to realize that all of the four drug categories are respiratory depressants. With the exception of the barbiturates and the narcotics, however, most of the useful drugs in these groups do not have respiratory depressant qualities which are clinically significant even in modest overdose. This characterization changes drastically when combinations of these agents are employed — what was a very safe drug with minimal respiratory depression becomes a potentially powerful respiratory depressant. Drug combinations are very beneficial and I recommend their use in place of any of the single drug approaches where a profound level of sedation is indicated. However, the practitioner must appreciate the clinical pharmacology of the agents he is using whether they are administered singly or in combination.

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Drug Combinations and Interactions

The use of sedative drug combinations to accomplish diagnostic and therapeutic endeavors dates back to at least the 1950s. The introduction of the phenothiazines, referred to as neuroleptics at that time, was soon followed by reports that a unique state of sedation could be achieved when a neuroleptic agent and a narcotic agent were given concomitantly. The first reports referred to this response as artificial hibernation. It was later named neurolep-

tanalgesia. It has been characterized as providing a transient state of apparent indifference to pain associated with a relative catalepsy.[3] It became apparent to physicians in the 1950s that neuroleptanalgesia would be very useful in the treatment of children.

The combination of meperidine, phenergan and chlorpromazine (Thorazine®) (also referred to as DPT or Lytic Cocktail) soon became popular in the medical

Administration of the phenothiazine or phenothiazine-like drug is best accomplished by oral administration of an elixir or tablets.

treatment of children and is still widely utilized. Since the Lytic Cocktail was introduced, clinical experience has indicated that chlorpromazine causes significant orthostatic hypotension. This potential side effect is not acceptable when patients are being treated on an outpatient basis. Hence, the original drug combination has been modified for pediatric dentistry by the elimination of chlorpromazine. In addition, most dental practitioners appear to have substituted alphaprodine for meperidine, and hydroxyzine is frequently substituted for promethazine.

Any of the narcotics in association with a neuroleptic will result in neuroleptanalgesia, but alphaprodine appears to have become the preferred narcotic drug based on its duration of action matching the usual length of clinical appointments. In addition, the degree of euphoria may be slightly higher for alphaprodine than the other useful narcotics.

Combining these two groups of drugs can be recommended for other reasons as well. In humans, narcotics are associated with the release of histamine. The antihistaminic properties of the phenothiazines and related drugs appear to ameliorate the uncomfortable response to the released histamine. Also, the antiemetic properties of the phenothiazines and related drugs antagonize the nausea and vomiting induced by narcotics. Thus, multiple useful drug interactions make the combined drug approach more efficacious than either single drug approach. However, the practitioner must appreciate that both agents are respiratory depressants. When used in combination, the dose of the narcotic is reduced from that dose which would be effective if a second drug were not used. Overdose of either agent may result in clinically significant respiratory depression when neuroleptanalgesia or any other drug combination is employed.

Adminstration of the phenothiazine or phenothiazine-like drug is best accomplished by oral administration of an elixir or tablets. This can be given in the office or at home. This route obviates the potential for localized tissue toxicity. Rectal suppositories are available for some of the phenothiazines and related agents if the patient is unwilling or unable to swallow a liquid or a tablet.

If the patient evaluation indicates that a light level of sedation will not likely suffice, then the patient may be given diazepam orally either in conjunction with, or after phenothiazine or related drug. The exceptionally fast gastrointestinal absorption of diazepam makes the office administration of this agent practical. If the level of sedation is clearly inadequate (i.e. the patient still disallows treatment) one hour after the last medication was administered, then the practitioner may elect to supplement with a narcotic.

If the patient is only slightly undersedated after oral and/or parenteral sedatives, the practitioner may elect to administer nitrous oxide and oxygen. Thus the practitioner may provide sedation one step at a time until the appropriate level of sedation is achieved.

General Comments and Recommendations

It is recommended that oxygen be administered throughout the period of effective sedation. The patient would thereby be better able to sustain a period of modest hypoventilation should the practitioner be delayed in noticing a deterioration of respiratory rate and/or volume.

The patient should fast for 4 hours before sedation. An early morning appointment is recommended in order to take advantage of the normal overnight fast as well as the practitioner's more acute senses. An early appointment also minimizes the mild dehydration that results from fasting.

Baseline vital signs should be recorded on every patient treated. If nitrous oxide/oxygen is administered alone, monitoring by almost any means is satisfactory (e.g., skin color and chest excursions). If the patient has received enteral and/or parenteral sedative drugs, then the patient should have blood pressures recorded periodically during the effective sedation period. It is strongly recommended that any patient successfully sedated with enteral and/or parenteral sedative drugs should be monitored with a precordial stethoscope and molded earpiece as is commonly done in the administration of general anesthesia. This monitoring system is inexpensive, comfortable for the practitioner, and extremely sensitive to both heart sounds and, perhaps more importantly, breath sounds.

I believe the most important vital signs to monitor

are the respiratory rate and volume. The average respiratory rates for 1, 3, and 5 year olds are 24, 22, and 20 respirations per minute, respectively. The average respiratory volumes (usually referred to as tidal volume) are 78, 112, and 130 ml, respectively. It cannot be overemphasized that all of the sedative drugs available are respiratory depressants. It is highly likely that any significant morbidity and/or mortality encountered during sedation of any kind will be the result of or involve respiratory depression. Deterioration of other vital signs can frequently be avoided by the appropriate treatment of early signs of respiratory depression.

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I am aware of the fact that some practitioners mix a phenothiazine or related drug with a narcotic in the same syringe and inject this solution submucosally at the site of a preceding local anesthetic injection. The stated rationale is that the injection hurts less. This technique should be discontinued for three reasons. The first reason is that if the local anesthetic solution contains a vasoconstricting agent (e.g., epinephrine), then the absorption of the sedative drugs can be substantially delayed. The second reason is that the phenothiazine or related agent is tissue toxic and may result in unnecessary tissue destruction and pain at the site of the injection. The third and last reason is that most patients in which sedation is indicated would benefit by receiving the local anesthetic injection after at least some of the sedative drugs have been given and are effective.

It is important to note that traditional guidelines for the establishment of drug doses in pediatric patients such as Clark's and Young's rules have commonly resulted in failure of sedation in the dental setting. These guidelines are no longer utilized or recommended for pediatric dental sedation.[4]

The child patient in whom sedation is indicated is usually in the age range of one to five years. In this group, successful sedations are usually close to general anesthesia in terms of central nervous system depression. Sedation is made more difficult and thereby less safe because the patient frequently cannot respond to verbal command due to his/her level of language skills. It is therefore imperative that the practitioner have knowledge and skills in recognition of abnormal ventilatory patterns, maintaining the airway and ventilations in the unconscious patient, as well as treating drug-induced respiratory depression.[4]

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