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Analgesia in Dentistry Now and in the Future ¹

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The use of so called analgesia by both inhalation and intravenous methods has been the subject of a tremendous amount of discussion within the past few years. Perhaps it would have been more correct to have said re-discussion, as the present interest in so called analgesia is a resurgence of what has occurred at intervals over the years. And yet, little seems to be gained from experiences of the past. It has been said that those who do not learn from mistakes of the past, are doomed to repeat them; and we seem to be repeating them.

One of our outstanding deterrents to a more comprehensive understanding and meaningful discussion and use of pain control, including so called analgesia in dentistry, is the lack of an acceptable nomenclature. Terminology is important from a standpoint of scientific discussion and understanding.

The use of various medications in dentistry has been referred to as "Intravenous Analgesia" when analgesia does not exist. Some use the term "Intravenous Anesthesia" and then imply that the patient is conscious and maintaining protective reflexes. At times, the term "Intravenous Sedation" is applied to states of recurring unconsciousness. To further confuse the issue, terms such as "chemanesthesia", "chemanalgesia", "hypoesthesia", "hypoanalgesia", and "neuroleptanalgesia" have been used. All lack an explicit meaning that would make a positive correct dialogue possible.

I must confess that on many occasions

when reading a scientific paper, casually talking with a colleague or reading a course description, I am uncertain as to the exact meaning of the terminology used. I am certain that many others, insurance companies particularly, are experiencing a great deal of confusion in attempting to understand exactly what state of altered sensorium is being produced on whom by whom.

Such is the state of so called analgesia in dentistry today. We are uncertain as to who should or should not undertake to accomplish this type of pain control. What should his background be? Should the learning experience be achieved as a pre-degree or post-degree instruction? How much of a pre-treatment evaluation is necessary? How much and what type of office help is required? What pre-operative preparation should be outlined for the patient? What physical class patients should be accepted in the office? What drugs are acceptable for office use? What post-treatment should be given to the patients? And last, but not least, how extensive should preparations be to treat an emergency? All this because of the lack of an understanding of the physiological deviations involved.

Before any of the foregoing questions can be answered with any degree of accuracy, certain fundamental aspects must be concisely determined. A meaningful term must be used that will denote exactly what the range of the patient's physiological alterations will be. I would like to suggest the use of the term "sedanalgesia", as we are attempting to lessen the impact of an unpleasant experience upon a conscious patient, by the use of sedation and analgesia. The situation could be further clarified by stating "nitrous oxide sedanalgesia", "intravenous sedanalgesia"

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or "morphine sedalgesia". Dr. Langa, in his text, suggested a similar idea when he used the terminology "nitrous oxide relative analgesia". While I do agree with his basic concept, I would like to preserve the word analgesia for its true meaning.

It is of fundamental importance to all concerned that not only the terminology be accurate and meaningful, but that a clear cut delineation be made between anesthesia and sedalgesia. It is of equal importance that the difference be appreciated.

Considering the drugs now available, the ability to control pain without the loss of consciousness, and the retaining of protective reflexes, would depend entirely upon the degree of noxious stimuli produced. In other words, the effectiveness of sedalgesia is in indirect proportion to the degree of painful stimuli. This dictates that to be effective in cases when the degree of painful stimuli is moderate to severe, regional or local analgesia must be utilized to block pain perception. The sedalgesic medication should reduce reaction to any real or emotional stimuli or stress, and may elevate the pain threshold to a degree dependent upon the drugs used.

To put forth the hypothesis that sedalgesia must be used in conjunction with regional or local analgesia to be successful in a large majority of cases is substantially documented. However, it can be explained also from a functional neuroanatomical point of view.

There are many aspects about pain which we do not understand. We do know however, that of all human sensations, pain has the greatest emotional impact, and that its intensity depends not only on the degree of the noxious stimulus, but on the state of mind at that particular time. This stresses the dichotomy of the pain sensation in that it must be not only perceived, but appreciated.

It stresses the fact that there can be no pain without consciousness. A noxious stimulus produced by an environmental change in tissues, produces an afferent nerve impulse which is not pain until it is interpreted and appreciated as such within the cerebral cortex. This is the very basis of general anesthesia.

In addition, to be functional, conscious-

ness and pain require three necessary aspects: one, the transmission of the afferent impulse from the periphery to the brain; two, the awareness that an impulse has arrived; and three, the ability to store and retrieve the message or memory. Without these three, there can be no consciousness and no pain.

These three aspects of the conscious state are served by three functional systems of the brain which are closely involved in a central nervous system integration. It is the close relationship of these three systems that make possible a control of consciousness, memory and emotions. These functional systems are: (1) the specific sensory system (lateral specific sensory spinal lemniscus pathway and, from the head, the spinal trigeminal tract); (2) the non-specific central core brain stem reticular formation); and (3) the limbic system.

Within the last quarter of a century, it has been recognized and appreciated that the central nervous system is a complex closely interrelated vertical organization of ramifying cell bodies and their processes. The specific sensory system, which is predominantly resistant to general anesthetics, carries pain impulses into the cortex by way of the thalamus and also feeds important collaterals into the brain stem reticular formation or non-specific system. The brain stem reticular formation which is a multi-neuronal, poly-synaptic pathway, is very much involved in maintaining a constant state of awareness. This system, in contrast to the specific sensory system, is easily depressed by general anesthetic agents and any depression of the activity of this system will impair consciousness. A sufficient depression of this system to produce unconsciousness is needed to overcome the perception and appreciation of moderate or severe impulses mediated by way of the specific sensory system. The limbic system is now believed to be involved in memory and emotion which affects both consciousness and pain.

The central nervous system as an organ differs from other organs of the body in that its proper function is dependent upon a sequential arrangement of each cell that comprises it, and depression of a cell or group of cells profoundly influences the

function of the whole. Thus, a seemingly small amount of a drug may induce varying degrees of consciousness. It is during these varying degrees of consciousness, that the reaction to pain may be exaggerated or obtunded depending upon the severity of the stimulus, subsequent impulses, and the state of consciousness.

It is thus evident that sedalgesia will, to a very great measure, depend upon the analgesic properties of the drug or drugs used, realizing that any and all drugs are limited in their ability to raise the pain threshold without the loss of consciousness.

Realizing that moderate or severe pain may be obtunded to a degree but not eliminated by sedalgesia and that consciousness and patient cooperation must be retained to facilitate accomplishing the required procedures as well as to prevent crossing over into general anesthesia with all of its inherent dangers, for the untrained, necessary criteria should be established for the sedalgesic state; these are:

1. Patient's mood should be altered;
2. Patient should be awake and cooperative;
3. The patient's pain threshold must be elevated;
4. The patient's protective reflexes should remain active;
5. There should be only minor variations in patient's vital signs;
6. There may be a degree of amnesia.

From the foregoing criteria, it is evident that the patient's mood can be changed with drugs without the loss of consciousness or the obtunding of protective reflexes. The pain threshold can be elevated, making the regional anesthesia more effective and last, but not least, the patient's physiological deviations can be minimized. This should render the treatment acceptable to a patient for whom it was previously unacceptable, from both an emotional and physical state.

Now that it is understood that the proper use of sedalgesia combined with regional anesthesia maintains a conscious, relaxed pain-free patient with all protective reflexes intact, the questions posed earlier can be accurately and meaningfully answered.

Any conscientious dentist with a desire to

utilize such a technique has the ability and scientific background to consider the use of this type of pain control. A dental school background, plus some additional training or work with another individual who is using this method of pain control should suffice. It is my opinion, based on many years of teaching dental students, that the use of drugs should be a part of the dental student's educational experience. All junior and senior students at the University of Pittsburgh School of Dental Medicine are taught, and do use, sedalgesia techniques with regional anesthesia.

Every patient should receive a thorough pre-treatment medical evaluation, be it prior to a local anesthetic alone, or with sedalgesia.

It is my opinion that a well trained dental assistant should be the only help needed as the patient is awake and cooperative with all protective reflexes intact and functional. If at any time the patient loses consciousness and is unable to maintain an airway or clear his own tracheo-bronchial tree, the patient has been allowed to pass from controlled sedalgesia to the lighter planes of general anesthesia with its accompanying hazards. This must be avoided. To insure the maximum of safety as well as the general comfort of the patient, solid foods should be restricted for at least six hours, and liquids for three hours prior to the appointment. Even though the patient is to remain awake and conscious, the chances of nausea and vomiting are greatly lessened with an empty stomach. Also, as sedalgesia will be indicated and used on an apprehensive patient, the abstaining from food for a period of time prior to the appointment is even more indicated. The patient should be instructed to have available a responsible adult to escort him home safely. Here again, it is imperative to bear in mind that although the patient will be awake and cooperative throughout, his judgment of distances, speeds and his ability to carry out precise maneuvers may be impaired as a result of the medication that has been given.

The physical class of patients that may be accepted for treatment in the office with sedalgesia techniques will vary greatly. In brief, it could be stated that any patient acceptable for treatment with local anes-

thetia alone, could be accepted for treatment using sedalgesia and local anesthesia.

The question as to what drugs might be considered acceptable for office use would depend, to a great deal, upon the experience and knowledge of the individual dentist. It is my opinion that while many drugs are available, only a few are indicated. To be even more effective and controllable, they should be administered by the inhalation or intravenous routes.

The inhalation route is the safest and most controllable method by which a drug can be given. The drug can be taken in and then breathed out practically unchanged. The lung and blood stream concentration can be altered at will giving the operator a greater measure of control.

Nitrous oxide thus becomes the prime choice, as to safety and controllability, of the agents that may be used for sedalgesia. Its weakness in anesthetic potency, becomes an advantage rather than a disadvantage. It is the only inorganic agent used in anesthesia and sedalgesia and has no deleterious effect on any organs or tissues. This is particularly so when used with a minimum of 50% oxygen which should be increased gradually during the administration. Sedalgesia should never use less than 50% oxygen and usually more. The additional fact that the gas is non-explosive is an advantage.

Methoxyflurane (Penthrane) has possibilities as an agent for sedalgesia. Its extreme potency is a disadvantage although its low vapor pressure (27) may affect this. Its use as a sedalgesic agent by the general practitioner is not advocated at this time.

At the present time three groups of drugs are indicated for intravenous use. They are: the hypnotics, narcotics and psychosedatives. The main group of hypnotics are the **barbiturates** with the so called ultra-short acting ones being favored. The rapid effect of the three commonly used barbiturates is probably due to their high lipid solubility and lack of ionization which permits an unimpeded crossing of the so called blood brain barrier. This rapid onset of central nervous system effect plays an important role in controlling the degree of depression and thus preventing overdosage. This is important in making intravenous sedalgesia with the barbiturates more acceptable.

Small doses of barbiturates can produce subtle changes in a patient's mood without other apparent physiological effects which may explain their usefulness for sedalgesia. It has been widely stated that the barbiturates have no analgesic properties and therefore can offer no relief from pain without producing unconsciousness. However, Keats and Beecher, have shown that the barbiturates may interfere with the transmission of the painful impulses by depressing the internuncial cortical neurons. Robson, Davenport and Sugryama have demonstrated that the antianalgesic effects of the rapid acting barbiturates is evident in severe or deep pains, but not to minor or superficial pains. It is possible that this may explain the effectiveness of the barbiturates when used in small doses for dental procedures that are not too painful.

The **narcotics** as a group are among the most useful and, yet, possibly the most misunderstood drugs used for sedalgesia and anesthesia. There is a strong belief that a large part of the pain relieving properties of the narcotics, are due to the calming and soothing effects of these drugs. This makes them ideal for intravenous sedalgesia, as they not only raise the pain threshold more than any other drug but they quiet anxieties and fear to a great degree. The sedative effect of the narcotic is unlike that of the barbiturate in that the patient is in more of a calmed, euphoric state, as opposed to the drowsy state with the barbiturates. The patients who receive narcotics are more cooperative than those who have been given either the barbiturates or the psychosedatives. While excitement may occur with the use of the narcotics, it is not common and does not present a problem in man. The narcotics are used most commonly in divided doses. By so doing, irritation of the veins is uncommon and the impact on the cardio-vascular system to produce hypotension is lessened. Patients who receive narcotics are more prone to nausea when they sit up suddenly or ambulate. They should be cautioned to move slowly or better yet, remain reclining for a period of time following the use of the narcotics. The onset, intensity and duration of the analgesic effect of the narcotics varies with the

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method of administration. Intravenous administration gives the most rapid onset (2 to 5 minutes) with the peak of analgesic effect occurring later (15-20). The duration of action, following the intravenous route of administration, is also shorter than following other routes of administration.

The psychotropic and psychosedative drugs introduced a new era in the alteration of patients' moods by chemotherapy. After using many drugs of this classification, diazepam (Valium) appears to be the most adaptable to outpatient sedalgesia techniques. It produces a marked calming effect probably due to its depressing action on the limbic system. It has a wide margin of safety and is comparatively short acting. Diazepam has minimal side effects with the most common being drowsiness and ataxia. An overdose will cause unconsciousness and airway problems associated with unconsciousness. Hypotension may occur, but as a rule is transient. The drug should not be mixed with any other drug or solution, but should be injected into the vein separately and slowly. Caution must be exercised when given diazepam to a patient who is to receive narcotics and barbiturates, as a potentiating effect may result. It has proven to be a most advantageous (for sedalgesia) drug when combined with local or local and the narcotics.

One of the newest non-volatile drugs introduced in anesthesia is Ketamine Hydrochloride. The drug can be given intravenously and intramuscularly and produces an unusual type of patient response. The onset of its action is rapid and in most cases the patient can maintain his own airway. As a rule, the cardio-vascular system is not affected by the drug. The elimination of pain without loss of consciousness is nearer with Ketamine than with any other agent. However, it does not produce a consistency of action that enables one to achieve a predictable efficiency. At present it does not seem to lend itself to outpatient sedalgesia

techniques. Its inconsistency, uncertain recovery times, and occasional uncontrolled reactions, are a deterrent for its use in the office of the general practitioner.

The post-treatment instructions given to a patient following office intravenous sedalgesia should be very similar to those given to a patient following an outpatient general anesthetic. The patient must be discharged in the company of a responsible adult. He must not be permitted to drive a car or do demanding work requiring judgment or manual dexterity. A time should be set when a patient could resume normal activities. It would be prudent to allow for a margin of safety in setting the time.

The preparations to treat an emergency when using sedalgesia techniques should be no more or less than what should be available in the dentist's office. Every dentist should have oxygen in the office, and a means of ventilating a patient. An emergency tray should be available. In general, being able to support respiration and circulation, and to control a convulsive seizure, are the principal emergencies requiring treatment.

As for the future of sedalgesia in dentistry—its use should increase tremendously. Every dental school should teach sedalgesia techniques so that the students understand its indication and contraindications, advantages and disadvantages, before they leave school. Local or regional anesthesia is now, and will be in the future, the solid basis for sedalgesia. The other drugs should be used to alleviate anxiety and apprehension, and, at times, to elevate the pain threshold and potentiate the local anesthetic. There is not now, nor will there be in the foreseeable future, a drug which is a panacea. Judging the future from the past, each new drug has solved a few problems, but added a few others. The future of sedalgesia lies in better education for the student, and a more sincere dedication from the practitioner.