Comparisons of Varying Dosages of Chloral Hydrate-Hydroxyzine with and without Meperidine for Managing Challenging Pediatric Dental Behavior: A Retrospective study of 35 years of Sedation Experiences

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Purpose: *This retrospective study compares the efficacy and safety of variable dosing of Chloral Hydrate – Hydroxyzine with and without Meperidine (Mep)for managing varying levels of anxiety and uncooperative behavior of young pediatric dental patients over a 35-year period.* ***Study design:*** *Reviews of the sedation logs of 2,610 children, 3-7 years were compared in search of what dosing proves safe and effective for differing levels of challenging behavior. Variable dosing of CH with and without Mep were judged using a pragmatic approach which defined sedation success as optimal, adequate, inadequate, or over-dosage using oneway analysis of variance. Descriptive analyses of behavior and physiologic assessment was included with regard to the extent to which physical restraint occurred to control interfering behavior. Arousal levels requiring stimulation, oxygen desaturation, and adverse reactions were included as indications of safety.* ***Results****: Where Mep was used, success rates were consistently higher; need for higher-end dosing of CH was not found beneficial when Mep was included. Significantly less need for physical restraint accompanied the addition of Mep.* ***Conclusions****: There appears to be strong basis for the safety and efficacy of the use of CH-H-Mep in combination at lower dosing than historically used. Addition of Mep was observed to enhance sedations, permit lower CH dosing, lessen or eliminate the need for physical restraint and adverse reactions.*

Keywords: Chloral Hydrate; Hydroxyzine ; Meperidine; children.

INTRODUCTION

During the course of the last decade, many changes have occurred with respect to the armamentarium of agents readily accepted and implemented for pediatric dental sedation. Foremost has seen the near withdrawal and disappearance of Chloral Hydrate (CH) an agent used for decades to overcome apprehensive and interfering pediatric behavior. The rationale for this occurrence appears both legitimate and understandable but not necessarily evidence-based.[1] Inadequate dosing, inadequate familiarity with the pharmacologic effects and its interaction with additional agents, and combination with toxic dosages of local anesthetic have generated numerous adverse reactions and in certain instances catastrophic outcomes. Analyses of such morbidity and mortality is believed highly related to operator error and clinician judgment. Withdrawal from manufacture of its oral elixir and termination of its use and place in most advanced pediatric training programs has left a void in the arsenal of agents for managing moderate and severely apprehensive and resistive pediatric behaviors particularly where lengthy visits are needed.

As result, a majority of advanced training programs have reported making sole use of midazolam.[2]

While a desirable if not utopian criteria suggests that agents chosen should possess reversal capability, only limited agents

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satisfy that criteria, and none manifest long durations of action. While acceptance of the use of physical restraint when sedative regimens alone fail to obtund interfering behaviors has become common place, recent surveys report it as diminishing. [3—6] Nevertheless deployment of restraints on the other hand, serves to confound if not obfuscate acknowledgment of what constitutes clinical success. In the early 1990's, CH was temporarily removed from production but later restored when an alleged claim of carcinogenicity was found to be false. In 2010, its manufacturer's oral elixir formulation of 500 mg/5 cc was terminated due to continued occurrence of mishaps inclusive of fatalities.[7] Incidents were believed attributable to inadequate clinician familiarity with dosing, failure to comply with existing sedation safety guidelines, and notably excessive use of local anesthetic dosing in which toxic levels were exceeded. [8—13] These incidents paralleled findings of a report by Goodson and Moore and others prior to the establishment of safety guidelines across numerous disciplines.[14,15] Failure to recognize potential for respiratory depression and airway embarrassment from inadequate patient monitoring justifiably resulted in the abandonment of agents. Today, availability of CH remains limited to tablet form and is subject to formulation by compounding pharmacists (a vanishing breed) willing and able to dispense in favorable tasting and small volume increments.

This project compares the use of CH in combination with Hydroxyzine (H) with and without meperidine (Mep) for management of challenging young pediatric dental behavior in a private practice setting from the experiences of the author over a 35-year period.

To date, there appears to be no universal agreement among pediatric dentists with respect to what constitutes clinical sedation success and the extent to which it is achievable. [16-18] First, what constitutes how success is defined? At one extreme, is the accomplishment of treatment visit objectives a sufficient criterion upon which to judge clinical sedation success where general anesthesia is avoided? Secondly, is persistent need for application of physical restraint to overcome interfering patient movement not a deterrent to disqualify declaration of clinical success? Lastly, does qualification or determination of success require that minimal or no use of restraint was needed? How clinicians and parents perceive the use of physical restraint (preferably referred to as "protective stabilization") as acceptable no doubt will ultimately contribute to resolution of this debate. From a perspective of research intended to assess the efficacy and safety of pharmacologic regimens, these issues have both academic and pragmatic implications. [19-23] To date, clarification of what constitutes a reasonably desirable success rate has not been presented. Achievement of a 50% success rate, a finding reported as commonplace when 50 mg/kg dosages (CH) were selected suggests results no better than a coin toss which at best implies weak judgment. Is 60-70% indicative of evidence-based success? Is 80% or greater reasonable to achieve? Despite its withdrawal, this author has yet to experience alternate regimens which provide more predictable and safety track records when combined with Meperidine.

The global objective of this study was to explore the effectiveness and safety of CH-H with and without Mep comparing ranges of dosing for varying levels of childhood anxiety and resistance.

Specific aims include:

1. What dosage ranges of CH-H alone or in combination with Mep best and safely enable treatment to be rendered with little or no need for persistent application of restraint?
2. Does the addition of meperidine significantly enhance the quality of sedation visits while permitting the use of lower CH dosing, thereby improving safety?

To date, few studies explored the impact of addition of meperidine to the combination of CH-anti-emetic. Nathan and West [24] retrospectively compared the responses of anxious children across 135 sedation visits using 50 and 70 mg/kg CH with and without Mep, with and without nitrous oxide. The addition of Mep was observed to significantly improve behavior. The use of higher-end dosing CH did not contribute to improved patient responses; to the contrary, subjects exhibited deeper than desired levels of sedation and somnolence. The addition of adjunctive nitrous oxide was found minimally effective when Mep was excluded; when Mep was included, the use of higher CH dosing was found unproductive and resulted in the occurrence of over-dosage and prolonged recovery.

Subsequent studies made use of a methodology that confounded interpretations of primary drug effects. [25- 29] Mandatory use of a restraint device and fixed concentrations (50%) nitrous oxide were applied for all subjects which compromised interpretation of patient movement, interfering behavior, and increased incidence of nausea/emesis attributable to either excessive or inadequate dosing of primary agents, and/or nitrous oxide.

Coincident with the findings of Nathan and West, Hasty *et al* (1991) [30] prospectively compared CH-H with and without Mep for anxious pediatric subjects and concluded that the addition of meperidine significantly enhanced the quality of sedations with low incidence of alterations in oxygen saturation, over-sedation, or need for physical restraint. From a research methodology perspective, this study represented among the most well- designed pediatric sedation study performed to date.

Needleman *et al* [31] retrospectively compared the effectiveness and safety of CH at 55 mg/kg with H at 1 mg/kg and nitrous oxide of 336 children over 382 sedation sessions. No significant differences of CH with or without H were reported.

Wilson *et al* [32] retrospectively reviewed records of 300 children 2-5 years of age who received either CH-H with and without Mep. Comparisons of behavioral and physiologic functions were made and found significant improvements under conditions where narcotic was included. Dosages studied, however, were not identified.

Choudhury and Vargas [33] reviewed the records of 116 sedations of 66 children ages 24-60 months of age using 25 mg/kg CH-H-Mep (1 mg/kg) with 50-% nitrous oxide. Subject selection criteria were not defined. Only comparisons between CH-H-Mep and Midazolam were made showing significantly improved behaviors from CH-H-M subjects. This was one of few studies that explored sedative as opposed to hypnotic dosing of CH.

MATERIALS AND METHODS

The present study offers a conceptual model in which to retrospectively assess efficacy and safety of pediatric sedation visits. Subjects were divided into three groups on the basis of varying levels of anxiety, using a diverse range of dosing of CH-H with and without Mep.

Subjects were selected on the basis of initial consultation, examination, and parental agreement/acceptance that treatment best considered the need for pharmacological assistance to minimize or eliminate the need for physical restraint. Subjects were included who had a history of unpleasant experience, or manifested uncooperative behavior and resistance on examination. For some, prior visits were reported by parents as having been aborted elsewhere or deferred for sedation as result of the occurrence of persistent interfering behaviors. Within the private practice setting, the objective of completing treatment needs utilizing a pharmacologic adjunct to avoid need for general anesthetic or need for restraint was presented to parents as desirable outcomes.

Data was secured from sedation logs accumulated over a 35 year period (1983-2018) of all visits in which entry level behaviors and treatment needs were assessed. Visits intervals were identified as either being mid-range (20-40 minutes) or long duration (>40-75 minutes). Visits of short and ultra-sort duration were excluded due to the long duration of action of CH. A Sedation log developed by the author was used until one developed by the AAPD in 2009-10 (and modified by this author) was used to record behavioral and physiologic responses at visit intervals, (pre-administration of agents, at time of local anesthetic, cavity preparation, immediate post-treatment, and when discharge criteria was satisfied). Pulse oximetry was maintained as well as qualitative and quantitative assessment of ventilation and tissue perfusion. Ratings were made with respect to the relative success of sedative regimens to permit treatment with no need for restraint, transient application, or persistent need for restraint.

IRB approval (140402002) was granted by the University of Alabama, Birmingham for this retrospective review of 2,610 pediatric sedation visits conducted in a clinical private practice setting. This study represents among the largest fraction of visits to date which focus on the use of CH combinations. In only rare circumstances have earlier studies compared varying dosage while none have compared varying levels of anxiety. Random samples of subjects receiving 25, 30,35,40,45 and 50 mg/kg CH-H with Mep were compared. Baseline comparisons were also made from these dosages without Mep.

Characteristic use of formulations of Mep have been recognized as possessing limited absorption (approximating 50%) due to extensive first-pass metabolism. [34] Subjects receiving 50 mg dosing in actuality absorbed 25 mg. Despite an absence of reversal for Chloral hydrate, an inherent plus is the availability of narcotic antagonist for reversal of potential respiratory depressant effects caused by Mep. Need for narcotic reversal, however, occurred rarely (<0.1%) in the study sample.

Additional Patient Selection Criteria

- Age Range: 30-84 mos; mean 48 mos.
- Weight < 70 lbs
- Sufficient caries to warrant visits of 30-75 minutes (due to the long duration of action of CH)
- Inability to permit treatment without persistent application of restraint, (as perceived by both parent(s) and clinician.
- Informed parental/guardian consent

Nitrous Oxide was excluded in its entirety in an effort to allow comparison of efficacy between drug conditions alone without confounding interpretation. Future prospective studies may be warranted which include subgroups receiving variable concentrations of nitrous oxide to assess adjunctive nature and opportunity to extend working times and potential to make use of lower primary sedative dosing to further enhance both efficacy and patient safety.

Where appropriate, statistical analysis made use of one-way ANOVA. Descriptive analysis of physiologic data was included. In addition, when comparing outcomes for near comparable dosing of subjects, differences were hypothesized to be statistically insignificant but sufficiently subtle to the extent that assertions were possible regarding how one dosage might prove more effective than another. The reader should focus on group differences between variable dosing to provide insights into what constitutes the most efficacious dosing.

Experimental groups were identified by the relative levels of anxiety and resistance manifested pre-operatively as falling into specific categories. These categories included mild vs moderate vs more severely anxious and resistive behaviors. (Tables 1,2 and 3).

Definitions of what constituted varying levels of anxiety

Mild: Minimum levels where some form of restraint was needed to overcome interfering or harmful behavior. Subjects responsive to nitrous oxide alone for the control of behavior was excluded. Behavior which interfered with securing routine dental x-rays, resistance to local anesthetic showing limited ability to accept invasive procedures. Subjects satisfying Frankl -1 ratings minimally qualify for this grouping

Moderate: Those behaviors above which include a higher degree of physical resistance to overcome interfering movement in a more than transient nature. Subjects falling between Frankl -1 and -2 ratings.

Severe: Heightened resistance necessitating persistent application of physical restraint for administration of local and invasive restorative or surgical care, reflecting Frankl -2 or worse ratings. For those in this category, the option of an unconscious technique was available.

Determination of Clinical Success

Clinical Success of a sedative regimen was judged by 2 independent raters at the conclusion of each visit as falling into one of the following classifications: Optimal, Adequate, Inadequate, or Overdosage. Inter-rater reliability was found high; few instances resulted necessitating operator

.**Optimal** level of sedation obtained: Maintenance of responsiveness to verbal requests for Cooperation without need for transient application for physical restraint; Absolute minimal or no need for restraint (exception might include parental hand-holding) to permit treatment to achieve visit objectives.

Adequate Success: Above with transient need for physical restraint to combat or overcome interfering, reflexive-type movement.

Inadequate : Unable to accomplish any or all treatment objectives due to persistent need for physical restraint.

Over-dosage: Subjects experiencing somnolence of a persistent nature intra- and post-operatively, with potential loss of protective reflexes, frequent oxygen desaturation below 90%, or somnolence which necessitated noxious physical stimulation eliminating the feasibility or appropriateness of declaring patient consciousness.

Latent periods observed

For the use of longer-acting sedative agents such as CH, a standard latent period has generally allowed 45-60-minute latent periods for drug absorption. For some, however, longer periods were required based on patient responses. Recognized as a disadvantage of the oral route of administration is the impact of anxiety on GI motility, gastric emptying, and drug absorption. In the presence of heightened anxiety, NPO requirements that extend beyond 6 hours or longer, or the previous evening's meal does not guarantee gastric emptying and drug absorption. In some cases, latent periods up to and exceeding 75 minutes were followed. Observation of subjects clearly manifesting no signs of sedation after 75 minutes were at the discretion of both parent and operator aborted for treatment. Alternative modalities were discussed and made available to parents at this juncture.

Parental Perspectives

Parents were surveyed prior to discharge of their assessment of the merit of choosing sedation for their child and whether they would consider its use in the future. This data and analysis are included in a subsequent manuscript.

RESULTS

Comparison of Regimens

Tables 1-3 depict respective patient responses to both variable dosing for CH-H regimens with and without Mep and differing levels of anxiety. The left portion of each table identifies the extent to which sedation was found efficacious by the criteria cited above. The middle portion of the tables explores the relative level of consciousness obtained and the degree of arousal from each regimen during and after treatment with respect to a subject's ability to respond verbally or the need for physical arousal. The right portion reports the percentage of cases aborted due to the persistence of interfering behaviors and the incidence of oxygen desaturations, agitation, and loss of protective reflexes, indicators suggestive of an inherent lack of safety.

Table 1 shows MILDLY apprehensive subjects responding favorably to CH-H without narcotic ranged from 60-84% (optimal or acceptable) levels of success. Ordinarily, this represents a desirable level of success considering the level of anxiety manifested. However, use of lower dosages in the direction to the sedative dosage (25 mg/kg CH) produced significantly better success ($p<0.05$) over the manufacturer's hypnotic 50 mg/kg dosage. This trend was found consistent across moderately and more severely apprehensive subjects as well (Tables 2 and 3). Almost without exception the vast majority of existing studies involving CH made use of the hypnotic dosing where a paucity of data exists comparing sub-hypnotic dosing. Highest success was found to occur ($p<0.05$) between 30-35 mg/kg. Relative success, using the full range of dosing, was not surprising when comparing low anxiety with the use of lower range dosing. It would seem logical that lower dosing would commensurately be needed when confronting respectively lower levels of anxiety and patient resistance. Alternatively, higher levels of anxiety as illustrated in Tables 2 and 3 might reasonably be expected to necessitate higher dosing.

With the addition of narcotic (Mep) successful responses (optimal and adequate) ranged from 77-90% ($p< 0.05$). Trends illustrate that the need for hypnotic dosage of CH was less productive compared to dosages of 25-35 mg/kg ($p< 0.001$).

The right side of Table 1 illustrates the extent to which subjects remained conscious and required only verbal vs physical arousal during and following treatment. Subjects receiving the hypnotic dosage of CH without narcotic manifested the greatest need for restraint and need for physical stimulation. That said, however, these occurrences were not of a frequent nature.

Table 2 Illustrates MODERATELY Apprehensive subjects

Without narcotic, optimal and adequate levels of sedation ranged from 52-60%. Need for persistent application of restraint ranged from 38-46%. Signs of over-dosage, somnolence, and need for referral for unconscious techniques emerged where Mep was not used for this level of anxiety and resistance. Addition of narcotic virtually eliminated the need for utilization of unconscious techniques, and need for physical stimulation to awaken somnolence.

For this grouping, dosing of 1.0 mg/kg and 1.5 mg/kg Mep were both found statistically more effective than non-narcotic combinations (70-93%, respectively). Onset of paradoxical agitation was found to minimally occur when narcotic was not used. Use of Mep was seen to reduce the need for higher CH dosing and produce the lowest incidence of adverse reactions.

Comparisons of differences for all dosing without narcotic were statistically insignificant; comparisons however, between all non-narcotic groups vs all narcotic groups were significant ($P< .001$) for moderate levels of anxiety.

Table 3: Shows **SEVERELY** Apprehensive Subjects

Without narcotic, optimal and adequate levels of sedation were observed at 44-52% of the visits in contrast with 74-84% with 1.5 mg/kg Mep ($P< 0.05$). Where 2.0 mg/kg Mep were used, success ranged from 80-94% .While what constitutes clinical success has yet to be precisely identified, the ability to accomplish treatment objectives in this percentage range while maintaining subject consciousness through discharge would conceivably qualify as impressive findings in clinical practice.

Inherent dangers of inadvertent induction of deeper planes of depressed consciousness can be expected to prevail when dosing reaches higher-end levels for heightened levels of anxiety. As such, herein lies the greatest demand for close attention to patient monitoring and availability of reversal and emergency management skills. It would seem logical to assume this level of anxiety would encounter the highest level of volatility in drug responses and necessitate higher-end dosing. The addition of narcotic posed statistically significant improvement over non-narcotic groups ($p<0.5$) for either narcotic dosage of 1.5 or 2.0 mg/kg. There were no significant differences between groups receiving 1.5 mg/kg and 2.0 mg/kg Mep. Interestingly, the hypnotic dosing of CH when combined with narcotic generated higher percentages of inadequate success, greater need for restraint and incidence of agitation. Similar to what was found with lower anxiety groups, the higher anxiety subset appears to respond more favorably to CH dosing in the 30-40 mg/kg range when narcotic was included. Use of 2.0 mg/kg Mep did not differ statistically from differing doses of CH.

DISCUSSION

Disruptive behaviors, particularly from those lacking in cooperative ability or unpleasant prior experiences, often are prompted by the need to protest an unpleasant situation and the impulse to protect oneself from perceived danger. Depending on the child's age and cognitive ability such behaviors can be seen as an attempt of the child to cope with a frightening situation. The inherent challenge for the clinician and parent is to avoid unpleasant and unproductive confrontations from the outset, protect the child's self-esteem, create an environment to facilitate the child's ability to ultimately accept care, foster a positive attitude toward care, and enhance the work quality of the dental team. For all intent and purpose, the use of sedative techniques serves to assist in achieving these objectives provided patient responses remain within the realm of consciousness and minimize the need for physical restraint and aversive measures.

Under circumstances where pharmacological approaches alone prove inadequate and persistent application of restraint is necessitated, achievement of the aforementioned objectives becomes compromised. Effective use of pharmacological techniques when conventional communication strategies prove inadequate has potential to permit clinicians to make use of non-aversive approaches for the apprehensive child. Unfortunately, there is to date a paucity of evidence-based support for the efficacy and safety of pharmacological remedies.

Numerous studies of CH-H offered fundamental rationale for the usefulness of an agent that produced profound effect on an ability to obtund resistive child behavior. Clinical impression and occasional text recommendations provided guestimates for pediatric dosing. Lampshire (1959) [35] suggested the basis for combining secondary and tertiary agents to offset the downsides of a particular single agent to provide what he termed "balanced medication." His insights provided the basis for consideration of combinations over single agents. Robbins (1967) [36] reported significant improvement in the effectiveness of CH when combined with an anti-emetic to overcome the GI upsetting nature of CH alone. He found that the addition of such permitted use of half the hypnotic dosage of CH and reduced incidence of nausea/emesis.

Having observed and experienced marginal success with hypnotic doses of CH, Trapp extended the manufacturer's recommended hypnotic dosing of CH from 50 to 70 mg/kg in a prominent and highly regarded pediatric dental textbook. [37] In a personal communication, Trapp indicated he did not have hard data to support the recommendation other than frequent unpredictable lack of success encountered with the 50 mg/kg dosing. [38]

Musselman and McClure [39] suggested that medications be classified and dosage determined by their ability to obtund varying degrees of resistance and the relative degree of invasiveness of a planned procedure. They described medications as being either "preventive medication," utilized to intercept deteriorating behaviors, thereby implying less potency, vs "management medication" for overcoming heightened anxiety and disruptive behaviors. While somewhat simplistic and conceptual,this thinking offered a useful framework upon which clinicians might initially pre-determine dosing needs. Such is consistent with findings that when combined with narcotic, low-range dosing of CH proves safer and more effective.

Inconsistent results and predictability led subsequent research to compare use of higher-end dosing and/or the addition of narcotic. Despite Robbins' findings, some clinicians advocated extending manufacturer's recommendations to use 70-75 mg/kg. [24,25,37]; while some hypothesized this might serve to improve outcomes, concerns emerged with respect to levels of depression achieved, prolonged somnolence, and airway patency.

Moore *et al* [15] compared the responses of four groups of 15 children to 20, 40, and 60 mg/kg CH with a placebo. Concerned about excessive dosing, airways were intentionally and temporarily obstructed by a head tilt maneuver to determine if sedated patients were able to self-correct their obstructions. 4 of 15 subjects receiving 60 mg/kg were unable to self-correct. Interestingly, placebo subjects responded more favorably than subjects receiving 20 and 40 mg/kg suggesting subject selection was not adequately anxious and that it should not be surprising that non-anxious subjects receiving 60 mg/kg CH would experience over-dosage. Despite definitive methodological shortcomings, [14,15] to their credit, these were among the first reports to draw attention to airway patency and the impact of sedative techniques on adverse children's physiologic responses.

Disappearance of CH from the arsenal of pediatric sedation leaves a void for management of lengthy visit treatment need. Diazepam, while possessing a broad range of safety and rapid rate of oral absorption demonstrates excessive duration of action, unpredictable efficacy, and active metabolites compromising recovery parameters and post-treatment management. The duration of action for Midazolam restricts efficacy and safety for all but short and ultra-short duration procedures. A similar study which parallels the present one compares a range of dosing of Midazolam preceded (in this journal) this report.

Downsides of CH Dosing–Paradoxical Excitement

The occurrence of paradoxical agitation from CH, manifested by bizarre, uncontrollable and inconsolable patient behavior during both latent period and commencement of treatment has largely been unaddressed let alone explained in the pediatric sedation literature. Its occurrence remains associated with dosing hypothesized as either inadequate or grossly excessive. Rather than a calming effect, it carries an alarming if not frightening event for parent and clinician alike to witness. Differential diagnosis, along with control of potentially harmful movement to preclude injury, is challenging between identifying the reaction as one which eventually will pass vs persist and necessitate airway and emergency management. Fortunately, its occurrence is not an often observed phenomenon as illustrated in Tables 2 and 3. The use of lowered dosing of CH may be hypothesized as basis for very low incidence of agitation observed in this study.

Limitations of the Study

There remains little disagreement that retrospective comparisons of sedation regimens do not match the methodological design strength of prospective studies from an evidence-based scientific perspective. That said, immense sample sizes, however, can serve to soften deficiencies of retrospective investigations. Among the challenges associated with pediatric sedation studies begins with subject selection. Both definition and selection of subjects with adequate levels of anxiety and limited coping skills presents difficulty. Selection is often limited to subjectivity and parental perceptions or reports of their child's cooperative ability. Rarely have valid and defined subject selection criteria been offered to enable sufficient sample sizes to be included. To draw conclusions regarding drug efficacy, experimental groups need show statistical uniformity from the outset. The magnitude of sample size in the current study enables comparisons between both drug conditions and varying levels of apprehension. Success rates were found to differ significantly between CH combinations with and without narcotic suggestive that the selection criteria were both valid and reliable.

Amongst concern which appear largely responsible for diminished use and selection of CH in combination has been the occurrence of depressed consciousness from hypnotic and higher dosing.

Data to support both efficacy and safety of sub-hypnotic CH dosing when narcotic is included as seen in this study serves to validate reincorporation of this regimen in the pediatric sedation arsenal. Achievement of clinical success in the ranges observed while minimizing need for persistent restraint

support this contention. It might be hypothesized that under conditions where the addition of narcotic permits lower dosing of CH, it might seem logical to observe a lower incidence of depressed consciousness and adverse respiratory effect. Availability of narcotic reversal remains favorable and as per the findings of this study were minimally required.

CONCLUSIONS

1. There appears to be significant basis for revival of the use of CH-H in combination with meperidine for managing varying levels of childhood anxiety and resistance.
2. The addition of meperidine to the combination has potential to enhance the quality, and predictability of pediatric sedations by permitting the use of lower-end dosing of CH; the use of dosing in the range of 25-35 mg/kg CH when narcotic is combined appears to negate need for Hypnotic dosing of CH for virtually all levels of anxiety,
3. Future studies should include varying levels of anxiety, resistance, and uncooperative behavior when comparing dosage demands
4. Prospective study is needed of several agents such as diazepam, triazolam, lorazepam, and ketamine. Future studies may seek to include comparisons of these agents with and without variable concentrations of adjunctive nitrous oxide-oxygen.

Disclaimer:

Despite any implications that suggest the combinations and dosing may be beneficial or more so than another should not serve as encouragement for use by the novice. Competency in airway management and proficiency in medical emergency management must be demonstrable by those making use of any of the regimens applied in this study.

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