THE OBJECTIVE MEASUREMENT OF SEDATION IN CHILDREN: A MODIFIED SCORING SYSTEM

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THE VALUE OF A DRUG as premedication before anaesthesia depends largely on its sedative properties. These are difficult to assess by subjective means alone or by any one simple test. Study of the objective signs of sleep and anxiety such as blood pressure, heart and respiratory rates led to the development of a simple scoring system¹ which can be used to evaluate the sedative properties of new drugs used for adult patients.^{2,3}

The scoring system used for adults is not necessarily applicable to children in whom the effect of sedatives before anaesthesia has usually been assessed by subjective methods.⁴ We have modified the adult scoring system and tested its ability to distinguish between large doses of sedative premedication, intermediate doses and a placebo, in a double-blind study.

METHODS

The children selected for study were all scheduled for elective eye surgery. Their ages ranged from 2 to 17 years (mean 6.4 years). Children with cardiorespiratory abnormalities and those with a history of abnormal mental development were excluded.

The test drugs used were oral preparations of diazepam 0.2 mg/kg (to a maximum of 10 mg); pentobarbitone 4 mg/kg (to a maximum of 200 mg); pentobarbitone 2 mg/kg (to a maximum of 100 mg). These drugs were compared with a placebo. The concentrations were such that each agent could be given in a volume of 1 ml/5 kg body weight. The drug given was selected by a double-blind technique using randomly arranged cards. The code of the random cards was not broken until the trial was completed. No atropine or hyoscine was given before induction of anaesthesia.

It was impossible to secure a constant ward environment essential for successful use of the adult scoring system.¹ The child was, therefore, given the sedative or placebo by mouth ninety minutes before operation while he was still in his own ward. He was then brought to a reception room where scoring was begun (Table I). Alertness, heart rate, blood pressure, respiratory rate and regularity were

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TABLE I
MODIFIED SCORING SYSTEM

	Score
Reception Area	
<i>Subjective</i>	
Apprehensive	0
Fully awake	1
Drowsy	2
Reception Area to Operating Room	
<i>Subjective</i>	
Cry or struggle	0
Apprehensive	1
Deterioration from drowsy or awake state	1
No change from drowsy or awake state	2
<i>Objective</i>	
Heart rate	
Rise > 30/min	0
Rise 15-30/min	1
No change	2
Blood Pressure	
Rise > 20 mm Hg	0
Rise > 10-20 mm Hg	1
No change	2
Respiration	
Grossly irregular	0
Rise > 4/min	1
No change	2
Reaction to Injection	
Cry or struggle	0
Wince or vocalisation	1
None	2

recorded. In this quiet environment he was observed to be drowsy or anxious but, if neither of these descriptions seemed appropriate, he was said to be fully awake. The child was then moved to the operating room and informed of an impending intravenous injection, all of which constituted the standard stimulus. Once he was settled on the operating table, a further subjective assessment was made of his alertness and anxiety. His heart rate, blood pressure, respiratory rate and regularity were again recorded. Finally, the intravenous injection was given and the child's reaction to it assessed and recorded in like terms.

Since the cardiovascular response of a child to anxiety may be greater than that of an adult, a greater change in heart rate and blood pressure following stimulus was required before an adverse score was recorded. The adult scoring system was also modified to include changes in respiration and response to the intravenous injection (Table I).

All assessments on all the patients were made in the same reception room and the same operating room by a single observer.

Classification of scores and analysis

Sedation was classified as good if the total score was 8 to 12, fair if it was 6 to 7 or poor if it was 0 to 5. Significant differences between the scores were sought using Student's t-test.

TABLE II
SCORES WITH DRUGS AND PLACEBO

Drugs	Scores		
	Good (8-12)	Fair (6-7)	Poor (0-5)
Placebo	12	6	12
Diazepam 0.2 mg/kg	20	3	7
Pentobarbitone 4 mg/kg	15	1	0
Pentobarbitone 2 mg/kg	11	0	3

TABLE III
STATISTICAL COMPARISON

Drugs	Probability (t-test)
Pentobarbitone 4 mg/kg v Placebo	P < 0.001
v Diazepam 0.2 mg/kg	P < 0.01
v Pentobarbitone 2 mg/kg	P < 0.01
Diazepam 0.2 mg/kg v Placebo	P < 0.01
v Pentobarbitone 2 mg/kg	P < 0.49
Pentobarbitone 2 mg/kg v Placebo	P < 0.1

TABLE IV
SCORES IN RELATION TO AGE

Age	Number	Scores		
		Good	Fair	Poor
2-5 years	50	29(58%)	8(16%)	13(26%)
6+ years	40	29(73%)	2(5%)	9(22%)

RESULTS

Sedative actions of the drugs used

The classification of scores is shown in Table II. The highest mean score, 10.2, was measured in patients receiving pentobarbitone 4 mg/kg (Figures 1, 2, 3 and 4) and was significantly greater than the scores of patients in the other groups (Table III). Identical mean scores were obtained with diazepam and pentobarbitone 2 mg/kg. Differences between the mean scores of patients given these agents and those given the placebo were not significant for the number studied.

The degree of sedation was unrelated to the age of the patient (Table IV).

Relationship of total score to individual tests

In the group classified as "good" individual tests of sedation relate well to the total score (Table V). In the "poor" group, rather better correlation was obtained between total score and individual tests than was the case in the previous studies with adults.¹

The two new measurements (change in respiration and response to injection) also showed a satisfactory relationship to the total score.

PENTOBARBITONE

FIGURE 1. Distribution of scores in children given pentobarbitone 4 mg/kg.

TABLE V
RELATIONSHIP OF TOTAL SCORE TO INDIVIDUAL TESTS

	Percentage of Cases		
	Good	Fair	Poor
Drowsy	29	0	0
No subjective deterioration	88	50	23
No rise in heart rate	95	70	27
No rise in blood pressure	74	70	18
No change in respiration	81	50	18
Satis. response to injection	84	60	32

Total score was compared to subjective assessment (Table VI). Eight cases graded as anxious in the operating room showed sufficient objective signs of sedation to be classified as "good."

DISCUSSION

The difficulties associated with and the limitations of arbitrary scoring systems have been discussed at length.⁵ The principal objective of preoperative medication

FIGURE 2. Distribution of scores in children given pentobarbitone 2 mg/kg.

TABLE VI
RELATIONSHIP OF TOTAL SCORE WITH SUBJECTIVE
ASSESSMENT

	Total	Good	Fair	Poor
Drowsy	17	17	0	0
Awake	33	33	0	0
Apprehensive	40	8	10	22

is to reduce to a minimum the child's anxiety as he is brought to the operating room. Of the drugs tested pentobarbitone 4 mg/kg proved most likely to fulfill this objective.

The main purpose of this trial, however, was to discover whether a simple scoring system based on subjective observations and measurable physiological changes could indicate the degree of sedation produced by drugs used for pre-medication. The system as presented proved capable of distinguishing the sedative known to be most effective clinically (pentobarbitone 4 mg/kg). Furthermore, there is a satisfactory agreement between the individual tests and the total score.

Having said this, it must be remembered that the difficulties of giving adequate

FIGURE 3. Distribution of scores in children given diazepam 0.2 mg/kg.

value or weight to an individual test remain. The values assigned in this system are somewhat arbitrary but the justification for their use is that they agree generally with the total score. Individual tests should be removed from the scoring system when their scores disagree with the total score.^{1,5}

In evaluating the degree of sedation produced by other drugs valid comparisons will be obtained if the circumstances of this trial are fundamentally unaltered. Using these drugs as an internal standard, variation in the population studied and the environment in other investigations could be readily detected and the system could be adopted for use in other centres.

The system has obvious limitations when sedative drugs in the doses used have associated strong cardiovascular or respiratory actions. In this trial, preoperative atropine and hyocine were omitted. None of the agents investigated had cardiovascular actions which would obscure the cardiorespiratory responses clearly associated with anxiety. In this system, unlike that used for adults, the effect of the stimulus is all-important because the control values are measured after the pre-medicant drug has been given. Thus any minor cardiovascular or respiratory changes effected by the drug are already present.

FIGURE 4. Distribution of scores in children given placebo.

SUMMARY

A scoring system has been devised to evaluate preoperative sedation in children. The system was tested in a double-blind trial comparing a placebo with diazepam (0.2 mg/kg), pentobarbitone (4 mg/kg) and pentobarbitone (2 mg/kg) in oral preparations. The total score (0-12) for each child was obtained by the addition of points acquired for subjective impressions and the changes in objective measurements of heart rate, blood pressure, and respiration when the children were given a standard stimulus. Scores of 0 to 5 indicated poor, 6 to 7 fair, and 8 to 12 good sedation. Of the drugs studied, pentobarbitone 4 mg/kg produced higher scores (mean 10.2) than the other groups, pentobarbitone 2 mg/kg and diazepam 0.2 mg/kg (mean scores 7.8) were superior to the placebo (mean score 6.2) but this difference was not significant in the numbers studied. This scoring system is thus capable of distinguishing between large and intermediate doses of sedative premedication and a placebo.

RÉSUMÉ

Nous avons imaginé un système de comptage pour évaluer la sédation préopératoire chez les enfants. Le système a été éprouvé par une étude à double inconnu où l'on comparait, en comprimés à prendre par la bouche, un placebo avec diazepam (0.2 mg/kg), du pentobarbitone (4 mg/kg) et du pentobarbitone (2 mg/kg). Le compte total (0-12) pour chaque enfant était obtenu par l'addition des points acquis pour les impressions subjectives et les changements observés dans la lecture de la tension artérielle, de la fréquence cardiaque et de la respiration lorsque les enfants étaient soumis à un stimulus standard. Le compte de 0 à 5 indique une sédation faible; de 6-7, convenable et de 8 à 12, bonne. Parmi les médications utilisées, le pentobarbitone 4 mg/kg, a produit des chiffres plus élevés (moyenne 10.2) que les autres groupes; le pentobarbitone 2 mg/kg et diazepam 0.2 mg/kg (chiffre moyen 7.8) ont été supérieurs au placebo (chiffre moyen 6.2) mais cette différence n'était pas significative, vu le nombre de cas étudiés. Ce système de comptage permet ainsi de distinguer entre des doses élevées et moyennes de prémédication préopératoire et du placebo.

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