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A Comparison of Psychologic Responses to Ketamine and Thiopental–Nitrous Oxide–Halothane Anesthesia

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Subjective psychologic responses to ketamine and to thiopental–nitrous oxide–halothane anesthesia, with two levels of preoperative information, were investigated in 48 young servicemen in a randomized, blind, prospective study. Ketamine produced a uniformly high incidence of illusions in both information groups, suggesting an intrinsic pharmacologic property of this drug. The combination of thiopental, nitrous oxide, and halothane also produced illusions, but their incidences were significantly lower than those with ketamine. The incidence of postoperative anxiety was no greater in patients who received ketamine than in those receiving thiopental–nitrous oxide–halothane. Patients who had received ketamine, with one exception, found the agent acceptable unless depth of anesthesia was inadequate to eliminate awareness during operation. (Key words: Ketamine; Halothane; Psychologic responses to anesthesia and surgery; Anxiety; Awareness during anesthesia and surgery.)

KETAMINE, a "dissociative" anesthetic agent, is associated with disorientation, sensory and perceptual misinterpretations, vivid dreaming, and hallucinations in some patients. Overall estimates of "emergence phenomena" with this agent range from 3 per cent to more than 30 per cent.[1] The true incidences of these phenomena have been difficult to determine, since differing dosage regimens, premedicants, techniques of administration, methods of data collection, and biases in reporting results have all influenced previous retrospective reports.[9] The present investigation was carried out to define more accurately the psychologic effects of ketamine.

Janis' 1958 study of psychologic stress in surgical patients[2] demonstrated that patients who knew what to expect in the postoperative period had fewer and less severe emotional problems than those who did not. Almost no mention was made of the role of the anesthetic in this study, except that considerable degrees of anxiety were attributable to anesthesia in many of these patients. We hypothesized that preoperative briefing concerning the administration of general anesthetic agents and their possible emergence effects would reduce the incidences of anxiety and adverse psychologic reactions during emergence. The study was also designed to assess whether a patient's "trait anxiety" mediated emotional reactions to ketamine.

Trait anxiety is defined as a basic, unvarying level of anxiety, integral to the subject's personality structure, and unaffected by short-term environmental stresses.[3] *State anxiety*, on the other hand, refers to immediate short-term anxiety or fear that a subject may experience in response to environmental or situational stresses that suddenly confront him.[3–5] The study was built around five hypotheses: 1) Ketamine will produce a higher incidence of "emergence phenomena" than the combination of thiopental, N_2O, and halothane. 2) The incidence of postoperative anxiety will be greater in patients who receive ketamine than in those receiving thiopental–N_2O–halothane. 3) Differing levels of trait anxiety will affect the incidences of preoperative and postopera-

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tive state anxiety. 4) Preoperative imparting of information concerning possible side-effects of ketamine will reduce the incidence of postoperative state anxiety, and that of adverse psychologic responses to "emergence phenomena." 5) The occurrence of "emergence phenomena" and/or postoperative state anxiety will affect future acceptability of ketamine in patients who have received this anesthetic.

Methods

The study contained four groups (A, B, C, D), each consisting of 12 young servicemen from a convalescent burn ward, in a single-blind, randomized 2×2 experimental design. All patients, considered to be A.S.A. Physical Status 2, were to undergo skin grafting or minor orthopedic procedures, and were judged suitable to receive either ketamine or thiopental–N_2O–halothane. No-one who had received ketamine previously was included in the study. Regardless of whether or not they were in the study, patients admitted to the convalescent ward section were immediately given the IPAT Trait Anxiety Scale[4,5] by a research nurse on the ward who told the patients that this was a special study. Thus, patients subsequently utilized in the study completed the scale without connecting it with our study.

The IPAT Trait Anxiety Scale,[4] designed by Dr. Raymond Cattell, is a self-analysis form consisting of 40 statements, which the examinee checks off as "yes," "in between," or "no." This scale has been extensively used to measure trait anxiety and is regarded as a proven, highly reliable instrument for this purpose. We used the particular form designed for individuals with an eighth grade, or higher, education, and compared our patients' scores with published norms for a male population of equivalent age and educational background.[4]

The anesthetist briefed his patients on the afternoon before operation. Those in Groups B and D were furnished with a detailed description of all emergence phenomena that we knew to occur with ketamine (see Appendix). Groups A and C received a minimal preoperative briefing, mentioning only dreams and altered depth perception as possible emergence reactions.

A third person reorganized the original 2×2 randomization subject assignments into two separate lists, list I, showing only whether the subject was to receive a minimal or a detailed preoperative briefing, and list II, showing only which of the two sets of anesthetics the patient was to receive. The anesthetist consulted list I and administered either a minimal or a detailed briefing, without knowing until immediately before operation, when he consulted list II, which anesthetic the patient was to receive. Thus, a source of bias in the preoperative interview was eliminated. A minimal, rather than a zero-information, briefing was used because ketamine, at the beginning of the study, was an investigational drug and the patients' informed consent was necessary. Only dreams and altered depth perception were mentioned as possible emergence reactions. The briefings were based upon a pilot study in which patients were given extensive postoperative interviews 24 hours following operation under ketamine anesthesia.

Atropine, 0.01 mg/kg, was given intravenously to each patient immediately prior to induction of anesthesia. Although atropine has behavioral effects,[6] an anticholinergic agent is needed when ketamine is administered,[1,7] and in the dosage used any behavioral effect of atropine should have been very slight.[6]

Groups A and B received ketamine intravenously as the sole anesthetic agent in an induction dose resulting in cessation of vertical nystagmus and response to commands, averaging 1.6 mg/kg, over 90 seconds. Reinforcing doses of 0.5–1.0 mg/kg were given as necessary to maintain this state.

Groups C and D received atropine, 0.01 mg/kg intravenously, followed by thiopental (4.5 mg/kg) for induction of anesthesia, then halothane in nitrous oxide and oxygen (3:2 l/min) by mask in a semiclosed circle-absorber system in a concentration sufficient to prevent movement in response to surgical stimulation. Inspired halothane concentrations ranged from 1.0 to 2.5 per cent.

Following operation, the patients were taken to a specially designated recovery area to be cared for by nurses and corpsmen who were not told which anesthetic they had received. However, the staff was told to treat each patient exactly like any other patient recovering

TABLE 1. Incidences of Illusions

	Ketamine		Thiopental-N_2O-Halothane	
	Minimal (Group A, 12 Patients)	Detailed (Group B, 12 Patients)	Minimal (Group C, 12 Patients)	Detailed (Group D, 12 Patients)
Experienced an illusion of some type	12/12	12/12	5/12	11/12†,‡
Visual illusion	12/12	11/12	4/12	7/12‡
Auditory illusion	7/12	6/12	1/12	5/12§
Proprioceptive illusion	12/12	9/12	4/12	7/12‡
Postoperative confusion	12/12	11/12	3/12	9/12*,‡

* $P < 0.05$ (C *vs.* D).
† $P < 0.01$ (C *vs.* D).
§ $P < 0.05$ (A + B) *vs.* (C + D).
‡ $P < 0.01$ (A + B) *vs.* (C + D).

from a general anesthetic, with no particular efforts made to reduce verbal or tactile stimulation.[1, 7] All patients were told where they were, that "everything was all right," and that someone would remain with them. Patients were returned to the ward when they could take fluids orally.

Twenty-four hours after operation, each patient in the study was interviewed by a physician unknown to the patient and not involved with his care, who knew neither the hypotheses of the study nor the study group assigned. First, the patient was given an open-ended sentence-completion form to fill out, which enabled him to describe his experiences in terms that he considered relevant (see Appendix). The patient was then given a check list (see Appendix). This enabled the patients to check off events which they might otherwise have lacked the verbal ability to describe in the sentence-completion form. (Had the check list been given first, the suggestion inherent in it would have biased the responses to the sentence-completion form.) Following administration of these two instruments, patients were cautioned not to talk about their anesthesia or the subsequent interview with others on the ward. Initially, each patient was asked if he had heard anything about ketamine from other patients. Only those who had not heard about the drug and who knew nothing about it in prior detailed questioning were included in the study.

Responses to the sentence-completion form were reduced to quantifiable data by a coding system, which, for each question, assigned the responses to a mutually-exclusive category (see Appendix). Within each question, categories were combined according to whether they indicated that an illusion or dream had occurred and whether the patient reported positive, negative, or zero affect in connection with these dreams or illusions. Because no hallucinations were reported, only illusions were included in the more generalized coding system. The distinction between hallucinations and illusions is based on definitions by the American Psychiatric Association:

> *Hallucination:* A false sensory perception in the absence of an external sensory experience.
>
> *Illusion:* The misinterpretation of a real, external sensory experience.[2, 8]

Check-list items, as well as the response categories on the sentence-completion section, were included in the more generalized coding system. Thus, we could determine whether a patient reported an illusion, dream, or adverse reaction to emergence phenomena in any part of either measure. By tabulating the numbers of patients reporting these phenomena in each of the four drug and information groups, it was possible to compare the numbers of patients reporting illusions, as well as those reporting dreams. We also could compare negative reactions to emergence phenomena. A secondary analysis of the data on illusions indicated whether each patient had visual, auditory, proprioceptive, or confusional illusions.

The individual who did the coding was blinded, as was the physician who conducted interviews. Reliability of the coding system

was checked by having a second person code by random selection 20 per cent of all the data sheets, and determining level of agreement.

Results

Table 1 compares the incidences of illusions in the four groups. This enables us to compare the effects of preoperative information for each drug. We also combined Groups A and B (ketamine overall), and Groups C and D (thiopental–N_2O–halothane overall), and compared these groups. This maneuver enables us to compare the two drugs in terms of the frequency with which they produce illusions.

The incidences of visual, auditory, and proprioceptive illusions and postoperative confusion were similar in the two ketamine groups: everyone who received ketamine experienced an illusion of some type. No patient experienced hallucinations. The differences between numbers of patients with illusions in the ketamine group and in the thiopental–N_2O–halothane group were all significant at the 0.01 level, except for auditory illusions, for which $P < 0.05$.

For thiopental–N_2O–halothane, the incidences of any illusions and of postoperative confusion were significantly higher in Group D, given detailed information, than in the minimal-information Group C ($P < 0.01$ and < 0.05, respectively), but the incidences of visual, auditory, and proprioceptive distortions were not significantly higher in Group D.

Table 2 shows the incidences of preoperative and postoperative state anxiety based on the sentence-completion form and check list. There were no statistically significant differences between groups receiving the same drug or between both ketamine groups together and both halothane groups together.

Data on preoperative and postoperative state anxiety as a function of the subjects' trait anxiety are shown in tables 3 and 4.

Patients' scores on the IPAT scale (see above) were tabulated and divided at the mean into two groups: those above the mean were designated *"high* anxious," and those at or below the mean, *"low* anxious." As we expected, the incidence of preoperative state anxiety was significantly higher in "high-anxious" patients than in "low-anxious" patients ($P < 0.05$). There was no demonstrable relationship between trait anxiety and postoperative state anxiety, either for ketamine or for thiopental–N_2O–halothane.

Table 5 shows the incidences of dreams and awareness during anesthesia and future preference for ketamine. The incidence of dreaming during ketamine anesthesia was 33.3 per cent, overall, and during halothane anesthesia it was 0 ($P = 0.01$). No one who received thiopental–N_2O–halothane reported awareness during anesthesia. In those who had received ketamine, however, future preference for this anesthetic appeared to relate to awareness, *i.e.*, three of the four patients from both Groups A and B who did not want ketamine again had been aware of operation. One patient in Group D (thiopental–N_2O–halothane, detailed information) did not want "ketamine" again owing to postoperative nausea.

Future preference for "ketamine" appears in table 6. The frequencies of occurrence of preference choices in the ketamine and halothane groups (overall) were tested by complex chi-square analysis. There was no demonstrable difference between the two anesthetics, nor were there any differences within groups receiving the same anesthetic.

After noting the higher incidence of dreaming and awareness during anesthesia with ketamine as compared with halothane, we tried to determine whether these factors were related to induction dose and/or total dose of ketamine administered to the patient. The mean induction doses of ketamine were the same (1.56 mg/kg) in Groups A and B. Likewise, there was no difference between the total ketamine dosages (0.140 mg/kg/min) in Groups A and B. No patient who received 1.7 mg/kg ketamine or more for induction reported awareness during operation. The incidences of dreaming during operation among patients who received less than 1.7 mg/kg ketamine for induction (12 patients) and patients receiving 1.7 mg/kg or more for induction (12 patients) were compared. Of the former, seven of 12 reported dreams, whereas in the latter group, only one of 12 reported a dream ($P < 0.05$). When the influence of total dosage of ketamine upon dream incidence was assayed, no difference between those doses be-

TABLE 2. Incidences of Preoperative and Postoperative Anxiety

	Ketamine		Thiopental-N_2O-Halothane	
	Minimal (Group A, 12 Patients)	Detailed (Group B, 12 Patients)	Minimal (Group C, 12 Patients)	Detailed (Group D, 12 Patients)
Preoperative anxiety (general fear and fear of anesthesia)	8/12	9/12	9/12	10/12
Preoperative anxiety (fear of operation only)	0/12	2/12	2/12	0/12
No preoperative fear of any type expressed	4/12	1/12	1/12	2/12
Postoperative anxiety	5/12	4/12	1/12	2/12

There are no significant differences in comparisons of A *vs.* B, C *vs.* D, or (A + B) *vs.* (C + D).

TABLE 3. Preoperative State Anxiety As a Function of Trait-anxiety Level

	Ketamine		Thiopental-N_2O-Halothane	
	Minimal (Group A, 12 Patients)*	Detailed (Group B, 10 Patients)*	Minimal (Group C, 11 Patients)*	Detailed (Group D, 12 Patients)*
Number of patients in each trait-anxiety level				
High anxious	8	7	4	6
Low anxious	4	3	7	6
Number expressing preoperative state anxiety				
High anxious	6/8	7/7	4/4	5/6
Low anxious	2/4	2/3	4/7	3/6

* Three IPAT's missing; hence, unequal N's for this comparison.

TABLE 4. Postoperative State Anxiety As a Function of Trait-anxiety Level

	Ketamine		Thiopental-N_2O-Halothane	
	Minimal (Group A, 12 Patients)*	Detailed (Group B, 10 Patients)*	Minimal (Group C, 11 Patients)*	Detailed (Group D, 12 Patients)*
Number of patients in each trait-anxiety level				
High anxious	8	7	4	6
Low anxious	4	3	7	6
Number expressing postoperative state anxiety				
High anxious	3/8	3/7	0/4	3/6
Low anxious	2/4	0/3	1/7	0/6

* Three IPAT's missing; hence, unequal N's for this comparison.

TABLE 5. Incidences of Dreams, Awareness, and Dissatisfaction with Anesthetic Agent Received

	Ketamine		Thiopental-N_2O-Halothane	
	Minimal (Group A, 12 Patients)	Detailed (Group B, 12 Patients)	Minimal (Group C, 12 Patients)	Detailed (Group D, 12 Patients)
Dream during operation	4/12	4/12	0/12	0/12
Awareness during anesthesia	2/12	1/12	0/12	0/12
Proportion not wanting "ketamine" again	2/12	2/12	0/12	1/12

TABLE 6. Future Preference for Ketamine

	Definitely Want Again	Wouldn't Make Any Difference	Don't Want Again	Total Patients in Group
Ketamine				
Group A	8	2	2	12
Group B	5	5	2	12
Thiopental–N_2O–Halothane				
Group C	10	2	0	12
Group D	6	5	1	12

Complex chi-square analysis:
1) (A + B) *vs.* (C + D) = not significant.
2) A *vs.* B = not significant.
3) C *vs.* D = not significant.

low the mean and those equal to or greater than mean total dosage was found.

Mean duration of anesthesia for both ketamine groups, together, was 37.8 minutes, and that for both thiopental–N_2O–halothane groups was 48.8 minutes.

Reliability between coders, 90 per cent, is well above 75 per cent, the accepted minimum reliability for coded data in psychologic research.[9]

Discussion

The results are discussed in terms of our five null hypotheses:

1) Ketamine will produce a higher incidence of "emergence phenomena" than thiopental–N_2O–halothane. Our results (table 1) indicate that there were significant differences between incidences of all illusions when ketamine, overall, was compared with halothane, overall. Therefore, the first hypothesis is borne out.

Moreover, the incidence of perceptual alterations was uniformly high in both the minimal-information and the detailed-information ketamine groups. We can infer from these data that ketamine possesses the property of producing illusions. Regarding thiopental–N_2O–halothane, the data in table 1 indicate that the incidences of postoperative confusion and of an illusion of any type were higher in the detailed-information halothane Group D than in the minimal-information Group C. The explanation for these increases is not clear. A suggestive effect of the preoperative briefing, in the case of halothane, can be postulated. In any event, it is interesting that illusions occurred in a sizable fraction of those receiving thiopental, nitrous oxide, and halothane. Our data lead us to believe that perhaps all general anesthetics can produce illusions.

2) The incidence of postoperative anxiety will be greater in patients who receive ketamine than in those receiving thiopental–N_2O–halothane. The data in table 4 indicate that there were no significant differences between postoperative anxiety in the two drug groups or *within* either drug group. Accordingly, hypothesis 2 is not borne out. Many clinicians who use ketamine feel that the illusions that patients experience are likely to cause postoperative anxiety and resentment. Much effort has been expended on a variety of regimens designed to decrease the incidence of emergence phenomena, like reducing verbal and tactile stimulation, administration of tranquilizing agents or barbiturates, and the like. Our data, on the other hand, indicate that the incidence of postoperative state anxiety following ketamine anesthesia in our population was no different from that following thiopental–N_2O–halothane, despite the illusions experienced. Moreover, most of our ketamine patients reported that they not only appreciated being told where they were and that they were "O.K." while awakening, but regarded this as essential to their orientation to reality. Therefore, we conclude that deliberate efforts to avoid verbal and tactile stimulation during recovery are not warranted, and may have an effect on anxiety and apprehension opposite to that desired.

3) *Differing levels of trait anxiety will affect the incidences of preoperative and postoperative state anxiety.* The definition of trait anxiety as integral to a subject's personality implies that this basic anxiety may activate state anxiety, referable to an object. Therefore, preoperative anxiety about the impending operation and anesthesia (state anxiety) would be expected to be significantly related to trait anxiety. This was indeed the case. However, *postoperative* state anxiety referable to emergence phenomena was *not* significantly related to trait anxiety in either drug group, so that this part of the hypothesis was not borne out. An alternative is that our measures of postoperative state anxiety were not sensitive enough to measure accurately the true incidence and, therefore, failed to show a relation to trait anxiety.

4) *Preoperative imparting of information concerning possible side-effects of ketamine will reduce the incidence of postoperative state anxiety and that of adverse psychologic responses to "emergence phenomena."* In the light of the discussion above, hypothesis 4 is not borne out. At first, we found this surprising, in view of the results of the Janis study.[2] A possible explanation may be that the minimal briefing was enough to attenuate anxiety in our patients to a level where it was not significantly different from that in the detailed-information groups. This possibility is supported by the similar incidences of preoperative state anxiety relative to anesthesia in all groups. A similar study providing no preoperative information will be necessary to confirm this.

5) *The occurrence of "emergence phenomena" and/or postoperative state anxiety will affect future acceptability of ketamine in patients who have received this anesthetic.* The data in tables 1–4 do not support this last hypothesis, since 20 of 21 patients who received ketamine with adequate anesthetic depth found it acceptable for future administration despite the presence of postoperative illusions and postoperative anxiety. Moreover, these 20 found ketamine as acceptable as did patients who received halothane (table 6). No patient who received an induction dose of 1.7 mg/kg or more reported awareness. When the induction dose was less, the incidence of awareness was 25 per cent. We realize that this is an isolated clinical observation and, at best, constitutes but one point on the dose–response curve. In order to make more definite statements, dose–response curves must be determined utilizing measured arterial blood concentrations of anesthetic and objectively reproducible measures of responses. However, the observation is useful, clinically, to the extent that routine use of an intravenous induction dose of 2.0 mg/kg of ketamine, followed by maintenance doses of 0.5–1.0 mg/kg, as necessary to maintain the state outlined earlier, can be expected to eliminate awareness in a comparable patient population.

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Appendix

Detailed Information Briefing

There are a couple of other things I'd like to go over with you in the way of things that you might notice as you wake up from the anesthesia. I'd like you to listen carefully and remember that none of the things that I'm about to read to you is harmful or dangerous, and they will all go away in a short time. Now here's the list:

1) You may see things double, or even in threes or fours, for a little while as you wake up—this will go away soon, though.

2) You may notice that things seem to be moving back and forth, or seem wavy for a little while.

3) Things may look far away for a while.

Anesthesia Evaluation Sheet - Page 4

The first thing I remember after I got the shot in the operating room is

Seeing the corpsman in recovery room

How did you feel when you first woke up? felt great

What did things look like? couldn't focus eyes when I opened both eyes - I saw double.

What did you hear? Heard people talking to me but I don't think I answered

How did your body feel? light

What were you thinking about? Wanting to get up out of the bed

I thought that I was lucky to be coming out of it as quickly as I was

FIG. 1. Sentence-completion form, sample page.

4) Colors may seem different to you, or brighter than normally.

5) You may feel very happy or feel like laughing.

6) Your hands and feet may feel different for a while, perhaps even like they don't belong to you, but will soon return to normal.

7) You may hear things louder, or differently than ordinarily, for a little while, and things may smell different for a little while.

8) You may feel hungry or thirsty as you wake up—if so, we'll give you something to eat or drink as soon as we feel it is O.K.

9) You may be a little confused as to where

Anesthesia Evaluation Sheet

Name RANDOM #25 Date _____

The following things sometimes happen after anesthesia, as you wake up or come out of it. If any of these things happened to you as you woke up, place a check mark in front of the item.

___ I felt cold

X I felt warm

___ I felt like I was somewhere else

___ My stomach felt upset

___ There was a ringing noise in my ears

X I felt hungry

X I felt thirsty

X I saw things double

___ Everything looked far away at times

___ I hurt a lot

___ Things looked like they were moving back and forth

___ My arms and legs felt different

___ It bothered me to have people talking to me

X I felt relaxed

X I felt like I was floating

X I felt dizzy

___ I felt like I was falling

___ I couldn't control myself

X I found myself saying funny things

___ I was confused

___ I felt afraid

X I didn't know I was operated on when I woke up

___ My eyes kept on moving around

Anesthesia Evaluation Sheet - Page 2

___ I felt happy

X I felt like laughing

___ The room was too noisy

___ I didn't want anybody to touch me

___ I would have felt better if nobody talked to me

___ I wanted to tell people things, but couldn't say what I wanted to say

___ Things looked brighter

___ I saw colors that I never saw before

X Whatever anybody did to me didn't bother me

___ I saw things that weren't really there

___ The room smelled different

___ I had trouble understanding people

___ I had trouble separating a dream world from reality

X Everything looked distorted

Of all the things that happened to me, the thing that I remember the most is ple. yelling for "Baby Sue"
Like I was in Vietnam

If I needed another operation, I would

X definitely want the ketamine again

___ wouldn't make any difference to me whether I got ketamine or the regular gas anesthesia

___ definitely not want to have the ketamine again

FIG. 2. Check list form.

you are when you awaken—in fact, you may find yourself saying things that later will seem strange to you, or odd—but this, if it happens, will only last for a little while.

10) You may feel warm, or cold, or tingly as you wake up.

11) You may feel a bit dizzy or like you are falling for a few minutes—this, if you experience it, will soon pass.

12) You may have some pain or discomfort after you wake up—if so, we'll give you some pain medicine to take care of it.

13) Your stomach may possibly feel upset for a little while as you wake up—if so, we'll give you some medicine to clear it up.

Remember, if any of the things I've mentioned should happen to you as you wake up from the anesthesia, that none of them is harmful and they will *all* go away in a little while. So, just relax and remember that the new anesthetic is a very good and safe one for you, and we'll see you in the morning.

Specimen Page from Coding Form [*]

How did you feel when you first woke up?

0 = Question not answered
1 = Normal, "o.k.," "fine," like I always feel, same as before I had the anes/operation, dash (——), etc.
2 = Pain, hurt a lot, hurt (where they operated—leg, arm, etc.)
3 = Temperature change—hot, cold, etc.
4 = Hungry, thirsty
5 = Sleepy
6 = Weird, strange, different; in another world
7 = Confused; didn't know where I was; mixed-up; things were all jumbled, confused, mixed up, etc.
8 = Disoriented as to space (*i.e.*, floating, body not belonging to patient, all sensory disorientation (vision, hearing, body)
9 = Like I was losing or had lost control (I felt like I was breaking up, falling apart)
10 = Fear or anxiety (scared, worried, uneasy)
11 = Comparison to a drug experience ("trip," like on pot, like J's; like marijuana; like LSD)
12 = Like drinking alcohol, liquor
13 = I didn't know they already had operated on me
14 = Concern about outcome of operation
15 = Relief that operation was over
16 = Dizzy
17 = Happy, real good

[*] The entire coding form, sentence-completion form, and check list are available on request from the authors.

Neonatology

TRACHEAL COMPRESSION Obstruction of the airway by one of the great arteries should be suspected in any infant who has repeated respiratory infections, especially stridor, apneic spells, or seizures. Obstruction may involve the trachea or one of the main-stem bronchi. The diagnosis of aortic arch compression is made by a plain chest x-ray or with barium swallow. Bronchoscopy is rarely indicated and may cause more difficulty. Compression by the pulmonary artery is frequently associated with congenital heart disease; and diagnosis may require cardiac catheterization. Surgical correction is more likely to improve function when compression is produced by the aortic arch. (*Park, C. D., and others: Tracheal Compression by the Great Arteries in the Mediastinum, Arch. Surg. 103: 626–632, 1971.*)