AWARENESS DURING ANAESTHESIA: A COMPARISON OF ANAESTHESIA WITH NITROUS OXIDE–OXYGEN AND NITROUS OXIDE–OXYGEN WITH INNOVAR®

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SINCE THE INTRODUCTION OF MUSCLE RELAXANTS by Griffith and Johnson[1] in 1942 it is possible to maintain anaesthesia at such a light plane that the patient may accidentally awaken, but be unable to communicate because of drug-induced paralysis. Several reports have appeared in the literature (Graff and Phillips 1959;[2] Hutchinson 1961;[3] Bahl and Wadwa 1968;[4] Crawford, Harley, Bland and Shah 1969;[5] Sia 1969;[6] Stephen 1969[7]). This problem is further complicated by the increased difficulty in estimating the depth of anaesthesia when muscle relaxants are used (Robson 1969[8]).

In modern anaesthesia, the tendency is to try to keep depression of the vital functions to a minimum, by employing light anaesthesia. This is especially important when there is pre-existing damage to one or more of the vital organs, and in long operations.

Apart from local anaesthetic blocks, the easiest way of achieving this is by combining nitrous oxide–oxygen anaesthesia with a muscle relaxant.

This study is concerned with the assessment of the patient's awareness for events occurring during and after surgery, when using two types of light anaesthesia.

METHOD

This study was carried out on 112 patients undergoing gynaecological operations. These patients were exposed to a fixed auditory stimulus in the form of tape recordings, as described by Brice, Hetherington and Utting in 1970.[10]

Preoperative medication consisted of atropine 0.6 mgm, combined either with meperidine (50–75 mgm) or promethazine hydrochloride (25–50 mgm), given one hour preoperatively by the intramuscular route. All patients were awake and co-operative before induction of anaesthesia and could converse coherently.

The patients were then divided at random into two groups:

In Group I (56 patients) anaesthesia was induced by thiopentone (250–500 mgm), the dosage depending on physical status and body weight, and a muscle relaxant was given for tracheal intubation. Anaesthesia was maintained by nitrous oxide (60 per cent) and oxygen through a semiclosed absorption circuit. Ventilation was controlled with a constant volume respirator (Air Shields); patients were moderately hyperventilated. A full paralysing dose of d-tubocurarine chloride or

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pancuronium bromide was given. Subsequent doses were determined by the usual signs of apparent tightness in the abdominal musculature, muscle movement and inflation pressures. At the end of operation the action of the relaxant was reversed by atropine 1.2 mgm and neostigmine 2.5 to 5 mgm.

In Group II (56 patients) anaesthesia was induced with 1 to 2 ml of Innovar (Fentanyl–Droperidol) followed by thiopentone 250–500 mgm as in Group I. The anaesthetic technique was the same as for Group I except that increments of Innovar (0.5–1 ml) were given at signs of lightening of anaesthesia (sweating, muscle movements, lachrimation, pupil dilatation or increase in blood pressure and pulse rate).

In both groups, a distinctive tape recording of music was played and the earpiece was inserted into each patient's ear, with the music playing at a comfortable volume. The tapes played were recordings of Tijuana Brass and a symphony orchestra. Each patient was exposed to only one 17-minute tape which was repeated at convenient intervals during the operation. Any muscle movement and the area of movement was noted.

At the end of anaesthesia, the patient was taken to the recovery room and remained there for a minimum of 45 minutes before being returned to the ward.

All patients were interviewed post-operatively within 48 hours and the following information was recorded:

1. Last memory before going to sleep.
2. Music heard and, if so, the type.
3. Recollection of any events during operation.
4. First recollection on recovering consciousness.
5. Any dreams; specify.
6. Degree of amnesia for events before or after the operation period.

Results

All the patients studied were female because of the large volume of gynaecological surgery carried out at this hospital.

The body weights of the patients varied widely, but most were over 120 lb. (Table I).

The majority were fit according to the ASA classification (Table II).

TABLE I

Body Weights of Patients

Body Weight	< 100 lb	100–115 lb	120–139 lb	140 + lb
Group I	4	14	20	18
Group II	0	7	22	27

TABLE II

ASA Classification

ASA	1	2	3	4	5
Group I	52	4	0	0	0
Group II	52	4	0	0	0

TABLE III

AGES OF PATIENTS

Ages	< 20 yrs	20–39 yrs	40–59 yrs	60–69 yrs	70 yrs +
Group I	0	30	21	4	1
Group II	0	27	25	3	1

TABLE V

NATURE OF OPERATION

Nature of Operation	Abdominal Hysterectomy	Vaginal Hysterectomy	Ovarian	Sterilization
Group I	13	24	4	15
Group II	19	23	3	11

TABLE V

DURATION OF OPERATION

Duration of Operation	Up to 59 min	60–119 min	120–179 min	180 min +
Group I	12	39	5	0
Group II	9	37	10	0

TABLE VI

INNOVAR DOSAGE

Innovar Dosage	< 2 ml	2 ml	3 ml	4 ml	5+ ml
Number of Patients	1	13	18	18	6

The ages of the patients ranged between 20 and 76 years (Table III).

All of the operations were gynaecological in nature (Table IV), and 78.6 per cent (Group I) and 83.9 per cent (Group II) lasted for more than 60 minutes (Table V).

During operation, the systolic blood pressure was maintained at approximately preinduction levels.

In Group II the Innovar dosage was kept low (Table VI) to avoid respiratory depression in the post-operative period.

All patients in both groups awoke rapidly at the end of operation and responded to commands before leaving the operating room.

POST OPERATIVE INTERVIEWS

1. *Last memory before going to sleep*

In Group I, one patient (1.8 per cent) had no recollection of the period immediately preceding surgery. She did not recall being brought to the operating room. Two patients (3.6 per cent) remembered waiting in the corridor out-

side the operating room, but nothing after. The remaining 53 patients (94.6 per cent) remembered being wheeled into the operating room and moving over to the operating table before induction of anaesthesia.

In Group II, one patient (1.8 per cent) remembered receiving the premedication injection in the ward. When she awoke again, she was already back in the ward. Four patients (7.1 per cent) recalled waiting in the corridor outside the operating room and nothing thereafter. Fifty-one (91.1 per cent) recalled the operating room and receiving an injection just before going to sleep.

2. *Music heard*

In Group I, one patient recalled hearing music during the operation and accurately identified the music played. She stated that she had experienced no pain and could recall nothing else of the events occurring during surgery. One patient stated that she heard music and accurately identified it, but thought that it had been before the induction of anaesthesia. She was therefore disoriented with regard to time. One patient thought that she heard music during the operation, but was very vague as to the title of the tune or the time. The other 53 patients in this group could recall neither the music nor any other events occurring during surgery.

In Group II, none of the 56 patients could recall music or any events occurring during the operation.

3. *First recollection on recovering consciousness*

In Group I, 48 patients (85.7 per cent) stated that they awoke in the recovery room and recalled various events that occurred there. Eight patients (14.3 per cent) did not remember the period of their recovery room stay, but thought that they awoke after returning to the ward. In Group II, 48 patients remembered the recovery room, while eight patients awoke in the ward. Hence these figures were exactly the same for Group I and II patients.

4. *Dreaming*

Group I – Two patients (3.6 per cent) recalled dreaming and the content of their dreams. Two patients (3.6 per cent) had vague memories of dreaming, but could not recall the content. Fifty-two patients (92.8 per cent) recalled no dreams.

Group II – No dreaming was recalled in any of the patients of this group.

5. *Clinical observations during operation*

Muscle movements and signs of light anaesthesia during operation.

Group I – Thirty-two patients (57.1 per cent) showed muscle movement of either the hands, face or legs or signs of light anaesthesia (rising blood pressure and pulse rate, lachrimation, sweating, pupil dilation).

Twenty-four patients (42.9 per cent) elicited no muscle movements or signs of light anaesthesia.

Patients in this group did not receive any Innovar.

Group II – Five patients (8.9 per cent) had muscle movements and signs of light anaesthesia.

Ten patients (17.9 per cent) had signs of light anaesthesia without muscle movements.

Forty-one patients (73.2 per cent) had no muscle movements and no signs of light anaesthesia.

6. *Emergence from anaesthesia*

In all patients of both groups, emergence from anaesthesia was smooth and without undue restlessness.

Discussion

When using light anaesthesia in combination with muscle paralysis, it is possible for the patient to temporarily "surface" into a zone of partial or complete awareness (Scott 1972).[11] Hearing appears to be the last sensation retained before loss of consciousness and is probably the first to return when consciousness is regained; hence this method of testing appeared justified to us.

94.6 per cent patients in Group I and 91.1 per cent in Group II could recall up to the moment of induction of anaesthesia, so that there was no significant retrograde amnesia in this series. Recall of music appeared to be definite in two patients in Group I, while a third patient was indefinite. None of these patients remembered experiencing any pain. In the Group II patients who received Innovar, there was no recall of music or of any other events.

In both groups, 14.3 per cent of patients were amnesic for the period of the recovery room stay. This property is possessed by many anaesthetic agents and is probably part of the depression of the central nervous system.

Patients anaesthetized with nitrous oxide and oxygen had an incidence of four dreamers (7.1 per cent) two of whom could recall the content and two could not. When Innovar was used as an adjunct (Group II), the incidence of dreaming fell to zero. This probably represents a deeper plane of unconsciousness, since dreaming only occurs in light planes of sleep. Brice *et al.* (1970)[10] in their series of 57 patients, using nitrous oxide–oxygen (75:25 per cent) and a relaxant, found no evidence of awareness in any of their patients, though the incidence of dreaming was 44 per cent.

During anaesthesia there was a significant increase in muscle movements in the group without Innovar, though there were often signs of light anaesthesia when Innovar was used as an adjunct to nitrous oxide–oxygen. The lesser amount of movement was probably due to the analgesic properties of the Fentanyl contained in Innovar.

This study shows that in spite of the appearance of muscle movement and signs of light anaesthesia, the incidence of awareness in these patients is very small indeed. There appears as yet to be no practical means of measuring depth of anaesthesia when relaxants are used; hence prompt action must be taken to deepen anaesthesia when signs of light anaesthesia appear. The addition of Innovar appears to be one way of achieving this. Another method is the intermittent addition of inhalational adjuncts (Scott 1972).[11] Brice, Hetherington, and Utting[10] found that the addition of 0.3 to 0.5 per cent halothane completely eliminated dreaming. This also appeared to be eliminated in our series with intermittent Innovar.

Summary

One hundred and twelve patients undergoing gynaecological surgery were investigated for awareness during anaesthesia with nitrous oxide, oxygen and a muscle relaxant both with and without Innovar® as an adjunct. When nitrous oxide (60 per cent) was used alone, 5.3 per cent of the patients were aware of an auditory stimulus in the form of recorded music. When Innovar® was added as an adjunct the stimulus was not heard.

The addition of Innovar® also reduces muscle movement, probably due to its analgesic effect. The incidence of dreaming was also reduced when Innovar® was added.

Anaesthetists have a responsibility to be certain that patients are not aware when under anaesthesia. With the relaxant techniques this means that adjuncts in the form of Innovar® or intermittent inhalational agents must be administered promptly when signs of light anaesthesia appear.

Résumé

Une étude fut entreprise sur 112 patientes qui subissaient une chirurgie gynécologique. Elles furent expossée à un stimulus auditoire constant à l'aide d'une bande magnétique. Les patientes furent divisées en deux groupes:

Le groupe I fut anesthésié avec du thiopentone, des myorelaxants, de l'oxygène et du protoxyde d'azote à 60 pour cent.

Le groupe II reçut en plus de l'innovar au cours de l'induction et lors d'apparition de signes d'anesthésie légère.

Dans le groupe I, 5.3 pour cent des patientes se rappelèrent le stimulus auditif enregistré, mais aucune ne ressentit la douleur.

Dans le groupe II, aucun patient ne se rappela le stimulus auditif.

Lorsque les agents myorelaxants sont utilisés, il est nécessaire d'administrer une substance adjuvante sous forme d'innovar ou d'un agent d'inhalation de façon intermittente rapidement lors d'apparition des signes d'anesthésie trop légère.

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