NON-VERBAL RESPONSE TO INTRAOPERATIVE CONVERSATION

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There is reason to believe that patients under general anaesthesia can hear. The literature examining the registration of auditory events during anaesthesia falls into physiological and behavioural categories. Auditory evoked responses are maintained under clinical concentrations of inhalation anaesthetics (Clark and Rosner, 1973; Rosner and Clark, 1973). With deeper anaesthesia, auditory responses at the cochlear nucleus increase markedly with response components maintained at the association cortex (Winters, 1976). The consequences of these registrations are difficult to deduce because of the postoperative amnesia which is a sequel of adequate clinical anaesthesia.

Behavioural studies have assessed this amnesia and found it to be quite impenetrable using normal measures of assessing memory. Using stimuli such as letter-word pairs or repetitions of single words (Dubovsky and Trustman, 1976), a poem, a fire bell and a list of words (Lewis, Jenkinson and Wilson, 1973) and music (Brice, Hetherington and Utting, 1970; Brown and Catton, 1973), both recall and recognition measures have revealed the amnesia familiar to those who have questioned convalescent surgical patients and led to the conclusion that discussion of clinical aspects of the patient's case need not be curtailed in the operating suite (Dubovsky and Trustman, 1976).

Other studies question this advice. Given registration of auditory events at the association cortex, research presenting neutral material may not impact upon the anaesthetized nervous system in the same way as material which is more meaningful to the patient undergoing surgery (Trustman, Dubovsky and Titley, 1977). Levinson's (1965) study examined this issue by staging a "mock" surgical crisis when, by EEG criteria, patients were in Stage III (deep) anaesthesia. Electroencephalographic changes indicating cortical arousal accompanied the crisis in three out of 10 patients. None of the 10 patients recalled the event, although in hypnosis four other patients claimed to. The patients with EEG changes became anxious during the hypnotic session and terminated their own hypnosis. Another study claimed highly therapeutic benefits from presenting positive suggestions addressed personally to the anaesthetized surgical patient (Hutchings, 1961).

This present report describes a double-blind study of postoperative response to intraoperative suggestions given to clinically anaesthetized surgical patients. The findings demonstrate a potential for

SUMMARY

In a double-blind study, 33 patients (herniorrhaphy, cholecystectomy and orthopaedic) were randomly assigned to either suggestion or control groups. Under known clinical levels of nitrous oxide and enflurane or halothane anaesthesia, suggestion patients were exposed to statements of the importance of touching their ear during a postoperative interview. Compared with controls, suggestion patients did touch their ear (tetrahoric correlation 0.61, P <0.001) and they did so more frequently (Mann-Whitney U test, P <0.02). All suggestion patients were completely amnesic for the intraoperative spoken suggestion, despite inquiries which included hypnotic regression to the operation.
reaction to personally meaningful operating room conversation. The reaction following surgery was non-verbal and was accompanied by complete amnesia. Consistent with the physiological literature on anaesthetic action, cortical areas of language understanding are relatively unaffected compared with midbrain and reticular structures. The finding may have relevance for the content of intraoperative conversation.

**PATIENTS AND METHODS**

Thirty-three patients from two university teaching hospitals were recruited for the study with Human Subjects Committee approval. Patients presenting for repair of an inguinal hernia (n = 13), removal of gall bladder (n = 12) and orthopaedic procedures (n = 8) participated. The interview with the patient before surgery explained that, throughout the operative procedure, patients would receive over headphones at a normal listening volume, one of two conditions: either a prerecorded tape or the actual operating room sounds and voices. An interview following the procedure would determine their memory, and would involve hypnosis as a possible aid to memory.

Standard anaesthetic practices were followed in all patients. This study was intended as a clinical investigation. As such, there was no interference with premedication or anaesthesia as assessed and administered by the anaesthetist, who operated totally independently. Induction of anaesthesia with thiopentone was followed by nitrous oxide and enflurane or halothane. Neuromuscular blocking drugs were administered to all patients. All medical personnel remained blind to the conditions in effect by the anaesthetist to have been aware during the procedure. No patient was reported to intraoperative statements. If patients respond to suggestive effect of intraoperative conversation. On the other hand, if patients do not respond, the amnesia may be the result of an inability of the nervous system to comprehend or store verbal input while under the influence of general anaesthetic agents.

Assignment to *suggestion* group or to the operating room sounds control condition (presenting actual operating room sounds) stereo microphones located in the outer shell of the earphones recorded these events while the earphones delivered them to the ears at the ambient volume. In the *suggestion* condition, a prerecorded tape was played at low volume. Beginning with the initial incision, the tape played continuously, suggesting rapid postoperative healing interspersed with music and songs. In order that patients would recognize it, the voice reading the message belonged to the presurgical interviewer. The 2-h tape was stopped 5 min before beginning reversal of anaesthesia if the surgery lasted less than 120 min; if surgery exceeded 2 h, the tape was started again from the beginning.

A special 3 min personal message was taped by the same individual who interviewed the patient and obtained consent for the study. It was played only for suggestion condition patients and then only once, approximately 5 min before beginning the reversal of anaesthesia. This message by a familiar voice was designed both to increase the effectiveness of intraoperative events by personally addressing the patient and stating the patient’s postoperative goals, and to suggest that a certain specific behaviour should occur during the convalescent interview. This suggestion stated, "(Patient’s preferred name), when I come and talk with you, it is very important that you pull on your ear so that I can know you have heard this. When I come to talk with you, you will pull on your ear. Your ear might itch a little and you will need to pull on it, or you might just know to pull on your ear. That way I will know you have heard this." The importance of the behaviour was again emphasized, "... so that doctors and nurses will know that you can hear in surgery."

The suggestion allowed for a non-verbal response to intraoperative statements. If patients respond to the suggestion with spontaneous observable behaviour during the “blind”, postoperative interview, support is thereby provided for the potentially suggestive effect of intraoperative conversation. On the other hand, if patients do not respond, the amnesia may be the result of an inability of the nervous system to comprehend or store verbal input while under the influence of general anaesthetic agents.

Assignment to *suggestion* group or to the operating room sounds control group was random by a 2:1 ratio (control n = 22, suggestion n = 11). The two samples otherwise did not differ from each other by age, weight or general physical condition. All were ASA
I or II, with no known mental disease.

The postoperative interview was conducted at least 2 days after the operation. One member of the two-person interview team was always the investigator who had obtained the patient's consent and whose voice was on the suggestion tape; both members were "blind" to the operating room condition. The interview was standardized and contained five structured parts developed in a previous pilot study. (1) It assessed present status and all memories for the perioperative period. This was followed by (2) assessment of ability to be hypnotized utilizing a standardized scale, the Stanford Hypnotic Clinical Scale involving an induction of hypnosis followed by five hypnotic suggestions: (a) motor automatism, (b) a hypnotic dream, (c) age regression to elementary school, (d) a posthypnotic suggestion, and (e) amnesia for the suggested scale items (Hilgard and Hilgard, 1979). Following this assessment and with the patient in the waking state there was (3) a discussion of the Scale with the patient and of the patient's willingness to proceed with the specialized hypnotic regression to the operation. Through a special programme based on dissociation theory (Hilgard, 1977) and using clinical hypnotic techniques, there followed (4) a hypnotic regression to the operation, with strong suggestions that memories for events during surgery would become conscious. Finally, (5) a discussion and debriefing ended the interview.

Being "blind" to the events during a patient's surgery, the interviewers did not bias the suggestion or control groups. All ear touching took place during non-hypnotic portions of the interview and was reliably observed by the interview team (r = 0.92).

RESULTS

Thirty-two of the 33 patients were interviewed; one control patient could not be interviewed.

Spontaneous verbal memory

Patients could not remember anything from the period following induction of anaesthesia until awakening in the recovery room or on the ward. This coincides with a reported incidence of less than 1% for conscious memories following anaesthesia, such recall being interpreted as the result of insufficient depth of anaesthesia (Hutchinson, 1960). By standard criteria, patients in our study demonstrated the post-anaesthetic amnesia which usually accompanies adequate general anaesthesia.

Non-verbal memory

Nine of the 11 suggestion patients showed at least one ear touch during the interview, as did nine of the 21 control patients. Table I gives the relevant data for the suggestion group, including the CNS-active anaesthetics they were receiving at the time of the suggestion. An exact 2 x 2 frequency table of the number of patients in each group who touched their ear produces Fisher's exact $P = 0.05$. This represents a tetrachoric correlation between specificity of response and group of 0.61 ($P < 0.001$). A further finding (fig. 1) was the difference in attention paid to the ear, which was significant by a Mann–Whitney $U$ test ($U = 49; n_1 n_2 = 231; P < 0.02$). Patient behaviour was therefore significantly affected by verbal statements made during general anaesthesia, although there was a complete conscious amnesia for the precipitating event under anaesthesia. No suggestion patient recalled the ear touching suggestion during any portion of the interview.

Memory under hypnosis

When regressed under hypnosis back to the operation, none of the 11 suggestion patients could recall the ear touching suggestion. This lack of retrievable memory, even in hypnosis, confirms the dense post-anaesthetic amnesia, but it is a retrieval failure rather than one of memory formation. This is deduced from the fact that the ear touching suggestion was clearly successful, although attempts at retrieving the memory of the suggestion were not.

![Fig. 1. Behavioural responses of patients in double-blind interview. Suggestion condition: nine of 11 patients showed ear pulls for a total of 66 earpulls for 655 s. Control condition: nine of 21 patients showed earpulls for a total of 18 earpulls for 98 s. Mann–Whitney $U$ test: $P < 0.02$.](https://academic.oup.com/bja/article-abstract/57/2/174/248538)
Despite the amnesia for the non-verbal suggestion, there were several examples in both suggestion and control groups of verifiable memory under hypnosis for intraoperative events. We provide two here and a fuller report is forthcoming. Patient 7 (table I) was a 22-yr-old Hispanic male who was not suggestible by the hypnotic assessment scale and he did not respond to the ear touching suggestion he received. However, from within his own self-generated hypnotic trance, he recalled the composer and musician of a taped selection played just before the ear touching suggestion. He was at the same level of anaesthesia for both events and, although clearly not suggestible, recalled, "a male voice speaking to me, telling me to relax" and "soothing music by Chuck Mangione, the same that I hum to myself. This man had a high anaesthetic requirement—3% enflurane with nitrous oxide and oxygen.

Another occurrence of apparent hypnotic recall was in the control group, from a 35-yr-old white female having a bone graft to her femur. At 40 min into a 205-min operation, with the patient receiving 50% nitrous oxide and 1% enflurane, the surgeon said, "We've (sic) got this all goof-balled here, didn't we . . . this is going to be a terrible bone graft. It's going to be the worst bone graft ever . . . this is going to be awful." In the double-blind interview, and in hypnosis, the patient recalled that something was wrong and, with further probing, "my leg, it's not going to work the way it should." Of our total study sample, only this patient was exposed to such a pessimistic remark in surgery. She had by far the longest convalescence of the 33 patients, requiring a total of 72 pain medications over her 14-day convalescence, twice that of the next demanding orthopaedic patient. A recent report (Weinberger, Gold and Sternberg, 1984) using rats showed strong aversive

**Table I.** Non-verbal responses to intraoperative suggestion made during postoperative interview. C = cholecystectomy, H = inguinal herniorrhaphy, O = orthopaedic procedures on the leg. †Anaesthetic concentrations in effect at time of suggestion for postoperative ear touching. ‡Total time of hand to ear contact. *Stanford Hypnotic Clinical Scale: increasing hypnotizeability scored 0-5
conditioning 2 weeks after white noise was paired with shock under deep chloral hydrate–pentobarbitone anaesthesia. During conditioning under anaesthesia, neither the ECG or the EEG showed changes from baseline values. The patient exposed to the pessimistic remark may have responded at a non-verbal level involving affective and autonomic systems, leading to a protracted recovery.

DISCUSSION

Through double-blind methods, this study asked if there might be a dissociative reaction to the suggestive content of operating room voices acting as a form of learning. The criterion of standard post-anaesthetic verbal amnesia was maintained while non-verbal behaviour (ear pulling) indicated learning of intraoperative events. Criticisms of this study might include the lack of a formal assessment of anaesthetic depth by end-tidal gas analysis or by the EEG. With controlled laboratory studies utilizing these indices showing registration of auditory events at the cortex under surgical concentrations of inhalational anaesthetics, the relevant issue for us was the nature of the postanaesthetic amnesia under usual clinical conditions. In studies of other amnesias, both organic and functional, it is apparent that amnesic patients, when appropriately probed, can often recall as much as do normal subjects, although free recall through spontaneous verbal memory is severely depressed.

In reviewing studies of learning during natural sleep, Evans (1979) has shown that linguistic messages can influence both sleep mentation and dreams as well as sleep behaviour. In one study, a suggestion to make a specific movement during sleep was given during Stage 1 REM sleep. The suggestion was paired with a cue word as a hypnotic suggestion. The word alone elicited the behaviour during later REM periods and, interestingly, over later nights of sleep. All subjects, however, were amnesic for the messages in the waking state, yet the verbally cued behaviour persisted during sleep. One subject showed behavioural responding 5 months after the original learning trial.

Adam (1979) has experimentally assessed verbal and non-verbal memory following exposure to sub-anaesthetic doses of inhalation agents. Test trials after recovery from anaesthesia showed performance which gradually increased in accuracy over 1 week. Thus, the recovery of memory over time following sub-anaesthetic exposure indicates that “the data do not support the expectation that general anaesthetics affect to a significant degree basic neurophysiological processes involved in memory formation such as memory trace decay or consolidation of traces.”

In reviewing the research of both functional and organic amnesias, Hirst (1982) cited studies with humans which indicate that verbal recall is not sufficient to assess memory for earlier motor and verbal learning trials. Our results from the operating room environment support these findings for post-anaesthetic amnesias.

The data in the present study establish the phenomenon of a non-verbal response to intraoperative conversation. The data show that the conscious amnesia required for clinically adequate anaesthesia is not a sufficient indicator of lack of responsiveness to operating room voices. The reaction may be entirely non-verbal, involving systems not accessible to ordinary memory retrieval. Language comprehension is a highly practised skill. The automatic nature of comprehending spoken language may continue at a neural level during states of surgical anaesthesia. Studies designed to assess awareness, perception, learning or memory during anaesthesia must utilize methods which are sensitive to known mechanisms of amnesia and neuropharmacology. We might expect the nervous system to remain responsive to pertinent linguistic messages during anaesthesia, although verbal recall will ordinarily be suppressed.

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