Anaesthesia
Journal of the Association of Anaesthetists of Great Britain and Ireland

Anaesthesia, 2011, **66**, pages 1088–1092 doi:10.1111/j.1365-2044.2011.06861.x

ORIGINAL ARTICLE

Ability of patients to retain and recall new information in the post-anaesthetic recovery period: a prospective clinical study in day surgery*

C. M. Blandford,[1] B. C. Gupta,[2] J. Montgomery[3] and M. E. Stocker[4]

1 ST5 Registrar in Anaesthesia, South West Peninsula Rotation, Royal Devon & Exeter Hospital, Exeter, UK
2 ST3 Registrar in Anaesthesia, Severn Rotation, Frenchay Hospital, Bristol, UK
3 Consultant in Anaesthesia & Critical Care 4 Consultant in Anaesthesia & Director of Day Surgery, South Devon Healthcare NHS Foundation Trust, Torbay, UK

Summary

Patients are frequently told new information in the early postoperative period and may retain little of it. Two hundred patients undergoing general anaesthesia for day surgery procedures were randomly allocated into two equal groups, 'Early' and 'Late'. Both groups were asked to undertake a simple memory test either in the early or late postoperative phase of their recovery. A list of five objects was verbally presented and recall of these five objects was tested after 30 min. A control group of 100 patients performed the same test. Patients in the control group received no sedative medications. Statistically significant differences ($p < 0.001$) in recall ability were demonstrable between each of the three groups. Twenty-three percent of patients in the 'Early' group had total amnesia of any test information given. Only 1% of the 'Late' group were unable to remember any information; a mean interval of 40 min separated the two groups. We recommend that verbal information given postoperatively be delayed until a recovery interval of at least 40 min, and should be supported with written material.

Correspondence to: Dr C.M. Blandford
Email: claireblandford@nhs.net
**Presented in part at the Anaesthetic Research Society Summer Meeting, Nottingham, July 2010, and the British Association of Day Surgery Annual Scientific Meeting, Leeds, June 2011*
Accepted: 28 June 2011

The amnesic effect of hypnotic drugs is well recognised and has been extensively researched [1–5]. During the immediate recovery period, declining levels of residual drugs will still be present with attendant effects. Day surgery patients are frequently told new information during the immediate recovery period, including fundamental details of their operative findings and also specific postoperative instructions. It is common practice in our day surgery unit for medical staff to see patients in this postoperative period, and not routinely follow up patients in the outpatient clinic; this is a growing trend in the present economic climate, given the drive for efficiency savings.

The anecdotal experience of one of the authors, who underwent surgery and then postoperatively berated her surgeon for failing to explain the findings, when in fact she had already sustained a 'lucid' conversation with the surgeon in the recovery room, prompted us to investigate whether information is given to patients too early, resulting in little recall of important information. The importance of clear, memorable information for patients about their healthcare, especially regarding discharge, is well recognised in the NHS patient survey programme [6].

We designed a prospective randomised study to simulate the provision of new verbal information to

patients in the postoperative period following day surgery procedures. Our aims were to ascertain the extent to which general anaesthesia affects a patient's ability to recall new information in the postoperative period, and whether timing affects the ability of the patient to recall this information.

Methods

All patients enrolled in the study provided written informed consent. Full ethics committee approval was granted.

A total of 302 patients were enrolled in the study: 202 undergoing general anaesthesia and 100 control patients. Recruiting and enrollment was done by one of three principal investigators. Patients were recruited consecutively over a period of 3 weeks in November 2009. All participants were attendees of the day surgery unit at Torbay Hospital. The day surgery setting was chosen firstly as total intravenous anaesthesia (TIVA) is used in over 90% of cases performed at the Torbay Day Surgery unit, which thus offers a high degree of anaesthetic standardisation, without implementing a prescriptive 'study' anaesthetic technique. Secondly, patients who are discharged on the same day as surgery have a higher need for accurate recall of important information, as there is no opportunity at a later stage to reinforce the information given, which otherwise may occur within an inpatient setting. The control group was recruited to provide baseline data, and consisted of attendees of the day surgery unit who were not receiving any sedative medications e.g. patients attending the day surgery unit for procedures under local anaesthesia, patients presenting for pre-operative assessment or patients' relatives.

All potentially eligible patients were offered the opportunity to participate. Our exclusion criteria were age under 18 or over 70 years and pre-existing or self-declared diagnosis of memory impairment. Patients were also excluded if English was not their first language. Following enrollment, the patients undergoing general anaesthesia were then randomly assigned to one of two groups: 'Early' or 'Late. Randomisation was performed by removing an opaque envelope from a randomisation bag. Twenty randomisation bags, each containing five 'Early' group and five 'Late' group envelopes, were prepared at the start of the study and used consecutively. There was no randomisation for the control group following recruitment. Patients' characteristics and anaesthetic details were recorded contemporaneously onto an Excel spreadsheet.

A TIVA technique with propofol was used in 95% of the cases in the 'Early' group and 92% of the cases in the 'Late' group. This reflects routine practice at the Torbay Hospital day surgery unit. Alfentanil was the most commonly administered intra-operative opioid (73% 'Early', 67% 'Late'). The standard regimen for the TIVA technique was 1 mg of alfentanil mixed in 50 ml 1% propofol, administered via a Fresenius pump and titrated with a target controlled infusion. We recorded the type of opioid given and the duration of the general anaesthetic. However, we did not record the number of millilitres of propofol remaining at the end of each case, to determine the exact dose of opioid given to each patient.

The recall test used was a verbally delivered test. Five objects, that would not have any particular relevance to individual patients, were selected to avoid bias. We chose to use abstract objects as surrogates, rather than medically related information, to avoid any potential confusion for patients, and also the ethical implications of providing patients with 'false' medical information. The recall test was delivered in a standardised scripted format, whereby the information was given to the patient once; they were asked to repeat it back and then told they would be tested on the objects 30 min later (Fig. 1).

The 'Early' group patients were given their test information whilst in the recovery unit, once they were assessed by a study investigator as being able to open their eyes to verbal command and able to converse with the recovery nurse. The 'Late' group patients were given their information 30 min after being discharged from the recovery unit and transferred to the secondary recovery ward area. In both groups, testing of their verbal recall was performed after an interval of 30 min from the time they were given the information. As the control group were not receiving sedating medications, they were presented with their test information as soon as practicable after enrollment. The testing interval was once again 30 min. At testing, participants were asked if they remembered being seen by a researcher and if they remembered being given the information. The correct number of items recalled was recorded in integers.

With a test score range of 0–5, it was deemed that a mean difference of 1 would be significant. Accordingly, power was calculated to be 99.7% given a sample size of 100 per group. Continuous variables were analysed with either ANOVA (with Bonferroni correction) or unpaired t-tests.

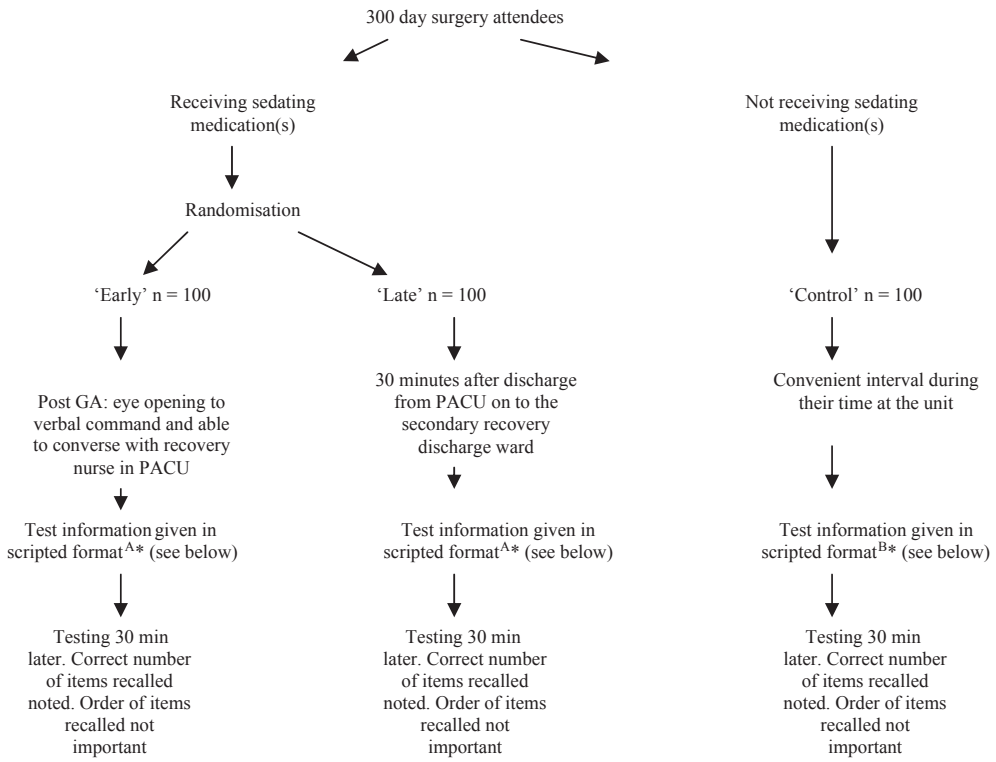

Figure 1 Flow chart detailing study protocol. Patients having day surgery procedures under general anaesthetic were randomly allocated to two study groups ('Early' and 'Late'), both of which were provided with new verbal information in the post-operative period. A third group of day surgery unit attendees were also recruited as controls to take the same verbal recall test for baseline data. *Scripted speech: ''A, Before your operation you/B Earlier you agreed to take part in a research project to test memory following an anaesthetic. The information that we would like you to remember will now be given to you. You will be given five objects to remember and the information will only be given to you once so please listen carefully. Guitar – Table – Pencil – Car – Banana. You will be asked to recall these five objects in 30 min''.

Results

During the study, a total of 327 general anaesthetic cases were performed at the day surgery unit. The case mix over this period was as follows: ear, nose and throat/maxillo-facial (79 cases; 24%), gynaecology (72 cases; 22%), urology (56 cases;17%), orthopaedic (46 cases;14%), upper gastro-intestinal/colorectal (29 cases; 9%), general (16 cases; 5%), plastic (16 cases; 5%); and vascular (13 4%). The surgical subspeciality of recruited cases was not separately recorded. However, all potentially eligible patients from every theatre list were offered the opportunity to participate in the study. We chose not to differentiate between specialities to enhance the breadth of our study population, and hence maximise the general applicability of results.

Two hundred and two patients who had undergone general anaesthesia cases were recruited. Two patients were withdrawn from the study before the test material had been presented; one patient was required to recover in theatre due to infection control reasons, and we were unable to get timely access to be able to perform the required testing; the second patient had already participated in the study on a previous visit to the day surgery unit, and was able to remember the test material.

Sex distribution and age of the remaining 200 patients and the 100 control patients are shown in Table 1.

There were no major differences in the anaesthetic techniques and intra-operative drugs administered between the two groups. The mean (SD) anaesthetic time was 30.4 (2.0) min in the 'Early' group and 37.1 (2.3) min in the 'Late' group ($p < 0.035$). The 'Early' group also had a decreased rate of opioid administration in recovery compared with the 'Late' group: one patient in the 'Early' group required opioids before receiving the information, compared with sixteen in the 'Late' group, and seven patients in the 'Early' group required opioids before testing took place compared with twenty patients in the 'Late' group (Table 2).

Table 1 Sex distribution and age of patients given information whilst in the recovery unit ('Early') or 30 min after discharge from the recovery unit ('Late') after surgery, and those not receiving sedative medications ('Control'). Values are number or mean (SD).

	Early (n = 100)	Late (n = 100)	Control (n = 100)
Male:female	36:64	36:64	37:63
Age; years	42.7 (12.6)	45.2 (14.3)	44.4 (13.6)

Table 2 Anaesthetic details for patients given information whilst in the recovery unit ('Early') or 30 min after discharge from the recovery unit ('Late') after surgery. Values are number or mean (SD).

	Early (n = 100)	Late (n = 100)
TIVA:volatile anaesthesia	95:5	92:8
Benzodiazepines	2	0
N_2O	1	0
SV:IPPV	41:59	49:51
Length of GA; min	30.4:(2.0)	37.1:(2.3)
Intra-operative opioids		
Alfentanil	73	67
Fentanyl	26	38
Remifentanil	22	25

TIVA, total intravenous anaesthesia; SV, spontaneous ventilation; IPPV, intermittent positive pressure ventilation.

The mean number of objects correctly recalled showed statistically significant differences between each of the three groups (Table 3). Twenty-three per cent of study participants in the 'Early' group had no recollection of being seen by a researcher postoperatively, or of having being given information to remember, despite all patients having sustained a 'lucid' conversation. This percentage fell to just one per cent for the 'Late' group. The mean time difference for this improvement was just 40 min. This illustrates not only a difference between the general anaesthetic and control groups, but also a significant improvement in recall ability, correlating with a longer recovery interval.

Although the 'Late' group had on average a longer duration of general anaesthesia and an increased rate of opioid administration, they still had superior recall compared to the 'Early' group.

Discussion

Only a small proportion of information presented to humans is successfully encoded and retrievable. Various factors have been postulated to affect this; one is the format in which material is presented, and written material is more easily recalled [7]. Psychobiological research has shown that memory is divided into four stages from extremely short-term memory through to long-term memory [8]. Immediate repetition of information is performed using short-term memory and implies registration. For recall, this needs to be converted into long-term memory, a process that involves protein synthesis and neural potentiation. There is evidence that the administration of protein synthesis inhibitors, 30 min after new information is given, fails to disrupt learning [9]. This indicates that the ability to remember information at 30 min is predictive of the information entering into long-term memory.

The conclusions of our study are based on two assumptions: firstly, recall at 30 min infers that patients will continue to remember such information; and secondly that our abstract markers are adequate surrogates for medical details. In light of the laboratory evidence cited above, the first assumption would appear neurobiologically correct. For the second point, we believe that there would be a greater incentive for patients to remember personalised medically relevant information, and therefore suggest that such material is unlikely to be better remembered than our abstract markers.

Table 3 Recall of objects (maximum 5) by patients given information whilst in the recovery unit ('Early') or 30 min after discharge from the recovery unit ('Late') after surgery, and those not receiving sedative medications ('Control'). Values are number or mean (SD).

	Early (n = 100)	Late (n = 100)	Control (n = 100)	p value
Number of objects recalled	1.85 (1.5)	3.4 (1.3)	4.4 (0.8)	<0.0001
Unable to remember being given task	23	1	0	<0.0001
Postoperative interval when information given; min	17.6 (1.6)	58.1 (1.7)	–	–

Quality and quantity of postoperative clinical information have been shown to be independent predictors of 30-day patient satisfaction in day surgery [10]. There are also implicit patient safety benefits to consider. Our study highlights that a significant improvement in a patient's ability to recall information is demonstrable if presentation of new information following general anaesthesia is delayed by a mean interval of 40 min. Extrapolating to clinical information; 'Late' group patients would reliably remember being spoken to postoperatively, and recall significantly more details of the content.

We acknowledge some limitations within our study. Although every practicable step possible was taken to minimise the chance that other patients may overhear the study participants, we could not guarantee this with complete certainty, as we were constrained to conducting the study in a busy clinical department. Also, we recognise that the verbal recall test, that was used is not a previously validated test. Nevertheless, we feel that the inclusion of the control group, whereby 60% of participants scored full marks as compared to 23% of the 'Late' group and only 5% of the 'Early' group, offers intrinsic validity to our test results and certainly illustrates an overall trend.

The 'Early' group had on average a shorter duration of general anaesthesia, and a decreased rate of opioid administration compared to the 'Late' group. Nonetheless, the 'Late' group still had superior recall compared to the 'Early' group. An increased opioid rate in the 'Late' group is to be expected given that patients had a greater postoperative interval at the time of study intervention. Hence, patients were more likely to have required additional analgesia during this period. However, we were unable to discern a reason for the increased surgical duration in this group.

In conclusion, we recommend that day case patients should be given new information postoperatively as close as possible to discharge, to maximise the recovery period, and hence their information retention. If possible, such verbal information should be supplemented in the written form. This study has lead to re-evaluation of the policies and procedures for healthcare professionals giving patient information in our day case unit.

Acknowledgements

We are grateful to Dr John Carlisle (South Devon Healthcare NHS Foundation Trust) for his assistance and advice regarding statistical analysis.

Competing interests

No external funding or competing interests declared.

References

1 Veselis RA, Pryor KO, Reinsel RA, Li Y, Mehta M, Johnson R. Propofol and midazolam inhibit conscious memory processes very soon after encoding: an event-related potential study of familiarity and recollection in volunteers. *Anesthesiology* 2009; **110**: 295–312.
2 Veselis RA, Reinsel RA, Feshchenko VA, Johnson R. Information loss over time defines the memory defect of propofol: a comparative response with thiopental and dexmedetomidine. *Anesthesiology* 2004; **101**: 831–41.
3 Padmanabhan U, Leslie K, Eer AS, Maruff P, Silbert BS. Early cognitive impairment after sedation for colonoscopy: the effect of adding midazolam and/or fentanyl to propofol. *Anesthesia and Analgesia* 2009; **109**: 1448–55.
4 Sarasin DS, Ghoneim MM, Block RI. Effects of sedation with midazolam or propofol on cognition and psychomotor functions. *Journal of Oral Maxillofacial Surgery* 1996; **54**: 1187–93.
5 Cole SO. Effects of benzodiazepines on acquisition and performance: a critical assessment. *Neuroscience and Biobehavioural Reviews* 1986; **10**: 265–72.
6 Picker Institute Europe. Key findings report for the inpatient survey, 2008. http://www.nhssurveys.org/survey/738 (accessed 02/03/2011).
7 Watson P, McKinstry B. A systematic review of interventions to improve recall of medical advice in healthcare consultations. *Journal of the Royal Society of Medicine* 2009; **102**: 235–43.
8 Gibbs ME, Ng KT. Psychobiology of memory: towards a model of memory formation. *Biobehavioural Review* 1977; **1**: 113–36.
9 Kentridge R. Investigations of cellular basis of memory: disruption of memory mechanisms, 1998. www.dur.ac.uk/robert.kentridge/bpp2mem2.html (accessed 16/06/2010).
10 Lemos P, Pinto A, Morais G, et al. Patient satisfaction following day surgery. *Journal of Clinical Anesthesia* 2009; **21**: 200–5.