General Anesthesia

Cognitive function is minimally impaired after ambulatory surgery

[La fonction cognitive est peu altérée après une intervention chirurgicale ambulatoire]

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Purpose: To evaluate the magnitude of subjective cognitive failure in the three days following general anesthesia (GA) for ambulatory surgery.

Methods: After Research Ethics Board approval, 258 patients undergoing general anesthesia (GA) and 250 patients scheduled for local anesthesia (LA) were recruited from our ambulatory surgical unit. Following the method of Tzabar, Asbury and Millar, patients were asked to complete the cognitive failures questionnaire (CFQ) before their procedure (with respect to the previous three days) and on the third postoperative day (with respect to their recovery period).

Results: General anesthesia and LA groups were similar in demographic make-up, except that the LA group contained more patients of American Society of Anesthesiologists physical status I (64.5% *vs* 52.7%, $P < 0.05$) and had significantly shorter procedure duration (25 *vs* 51 min, $P < 0.01$) than the GA group. Median preoperative CFQ scores (interquartile range) were 26 (18) for the LA group and 26 (18) for the GA group. Postoperative CFQ scores were 25 (20) for the LA group and 28 (22) for the GA group. There was no significant difference in preoperative CFQ score between groups (Mann-Whitney U). When preoperative and postoperative CFQ scores were compared, the small increase seen in the GA group was statistically significant ($P < 0.05$, Wilcoxon).

Conclusion: A statistically significant impairment of cognitive function in the three days following GA, but not LA was found. However, the magnitude of this impairment was small, and is of doubtful clinical significance. Modern ambulatory anesthesia may cause less delayed cognitive impairment than was previously thought.

***Objectif** : Évaluer l'importance de l'atteinte cognitive subjective au cours des trois jours suivant l'anesthésie générale (AG) pour une opération en chirurgie ambulatoire.*

***Méthode** : Le Comité d'éthique de la recherche ayant donné son accord, 258 patients devant subir une AG et 250 patients, une anesthésie locale (AL), ont été recrutés en chirurgie ambulatoire. Nous avons utilisé la méthode de Tzabar, Asbury et Millar et demandé aux patients de remplir le questionnaire sur les défaillances cognitives (QDC) avant leur opération (concernant les trois jours précédant l'opération) et le 3^e jour postopératoire (selon la période de récupération).*

***Résultats** : La composition démographique des groupes AG et AL a été similaire, sauf que le groupe AL comptait plus de patients d'état physique I ASA (64,5 % vs 52,7 %, $P < 0,05$) qui ont subi une opération significativement plus courte en moyenne (25 vs 51 min, $P < 0,01$) que ceux du groupe AG. Les scores préopératoires médians au QDC (intervalle interquartile) ont été de 26 (18) pour le groupe AL et de 26 (18) pour le groupe AG. Les scores postopératoires ont été de 25 (20) pour le groupe AL et de 28 (22) pour le groupe AG. Il n'y a pas eu de différence significative de score préopératoire entre les groupes (test U de Mann-Whitney U). En comparant les scores préopératoires et postopératoires, on découvre une petite augmentation qui est statistiquement significative dans le groupe AG ($P < 0,05$, Wilcoxon).*

***Conclusion** : Une atteinte statistiquement significative de la fonction cognitive a été trouvée pendant les trois jours qui ont suivi l'intervention chirurgicale sous AG mais non sous AL. L'importance de cette atteinte est toutefois minime et peu significative cliniquement. L'anesthésie ambulatoire moderne cause moins d'atteinte cognitive différée qu'on ne l'avait d'abord cru.*

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THE recovery of cognitive function after ambulatory anesthesia has been well studied in the short term (immediate awakening up to 24 hr).[1] In the past, the use of anesthetic agents with prolonged recovery profiles was associated with delayed cognitive failure (24 hr up to several days after anesthesia).[2–5] However, much of the work demonstrating delayed cognitive impairment after general anesthesia (GA) took place before the advent of short acting anesthetic agents such as sevoflurane, desflurane and propofol. When these agents are used, evidence for the impairment of cognitive function beyond the immediate recovery period is less clear-cut.

The cognitive failures questionnaire (CFQ) is a subjective test designed to investigate failures of perception, memory and motor function.[6] The questions refer to 'real life' situations and may provide more useful information about cognitive function than contrived psychomotor tests such as the Trieger dot test or digit recall. It is an established tool used to measure cognitive dysfunction, and has been well validated.[7–10]

In 1996, Tzabar, Asbury and Millar used the CFQ to investigate cognitive function after ambulatory anesthesia.[11] They demonstrated a higher incidence of subjective cognitive failure in patients receiving GA compared to patients receiving local anesthesia (LA). However, results were based upon limited data from 54 subjects undergoing GA and 30 undergoing LA. A wide variety of surgical procedures were included, and the anesthetic technique was not standardized. We aimed to study subjective cognitive failures in day case patients using a larger sample size and modern anesthetic techniques.

Methods

Ethical approval for this study was granted from the Hospital Research Ethics Board. Written informed consent was obtained prior to enrolling patients in the study. Two hundred and fifty-eight patients undergoing GA and 250 patients scheduled for LA were recruited. Patients were not randomized into general or LA groups. Inclusion criteria were: elective ambulatory patients undergoing general surgery, plastic surgery or orthopedic procedures, American Society of Anesthesiologists (ASA) physical status I or II. Exclusion criteria were: patients taking regular sedative or narcotic medication, patients requiring admission after surgery, chronic alcohol consumption or history of psychiatric disease.

The general anesthetic technique was standardized. Anesthesia was induced with *iv* midazolam 1 to 2 mg, fentanyl 50 to 200 µg *iv*, and propofol 100 to 300 mg *iv*. Maintenance was achieved with desflurane or sevoflurane, with or without nitrous oxide. Patients receiving LA did not receive intraoperative sedation of any kind.

The CFQ consists of 25 questions regarding common lapses of cognitive function, including memory, perception and attention (Appendix, available as Additional Material at www.cja-jca.org). Each question is scored 0 to 4 depending on frequency of occurrence, as rated by the subject. High scores relate to increasing frequency of cognitive lapses. The overall CFQ score is calculated by the addition of all 25 questions, and thus has a maximum of 100.

The CFQ has been extensively used to assess cognitive failures in healthy individuals, in those suffering from mental or physical illness, and in patients recovering from the effects of anesthesia.[6–11] The questions of the CFQ were originally designed to record cognitive lapses occurring during the previous six months. For the purposes of this study, patients were asked to consider only those lapses occurring during the previous three days. Patients were asked to complete the questionnaire before their procedures (with respect to the previous three days) and again on their third postoperative day (with respect to their recovery period). Postoperative questionnaires were returned to the hospital by mail.

Data were analyzed using SPSS 11.0. Demographic data were analyzed using the Chi-square test. Cognitive failure questionnaire score results were treated as nonparametric data. Intra-group comparisons were made using the Wilcoxon signed rank test. Comparisons between groups were made using the Mann-Whitney U test. Sample size was calculated at 211 per group using a standard deviation of 11 units (from the work of Tzabar *et al.*),[11] $ß = 0.8$ and $P = 0.05$. A difference of three units was considered clinically significant. A dropout rate of 20% was anticipated, giving a target of 253 per group.

Results

Two hundred and fifty-eight patients were recruited in the GA group, and 250 in the LA 'control' group. Full preoperative and postoperative data were returned for 207 patients in the GA group (80.2%) and 204 patients in the LA group (81.6%). Demographic data for subjects who returned complete questionnaires are shown in Table I.

There were no significant differences between patients who received GA *vs* LA in terms of age, gender or body mass index. There were more patients of ASA status I in the LA group than in the GA group (64.5% *vs* 52.7%, $P < 0.05$). Procedures performed

TABLE I Demographic data for local anesthesia and general anesthesia groups

	GA group *n = 207*	*LA group* *n = 204*
Age (yr)	47 ± 17	49 ± 18
Sex (% male)	52	54
BMI	27 ± 6	26 ± 16
ASA I/II (*n*)	109/98*	131/72
Surgery duration (min)	51 ± 23**	25 ± 7

GA = general anesthesia; LA = local anesthesia; BMI = body mass index; ASA = American Society of Anesthesiologists' physical status. Values are mean ± SD unless specified. *$P < 0.05$, **$P < 0.01$.

TABLE II Demographic data for subjects excluded due to failure to return full questionnaire data

	GA group *n = 51*	*LA group* *n = 46*
Age (yr)	44 ± 17	41 ± 18**
Sex (% male)	45	63
BMI	29 ± 5	25 ± 3
ASA I/II (*n*)	24/27	36/10
Surgery duration (min)	52 ± 21	24 ± 5

GA = general anesthesia; LA = local anesthesia; BMI = body mass index; ASA = American Society of Anesthesiologists' physical status. Values are mean ± SD unless specified. **$P < 0.01$ compared to subjects who returned completed questionnaires.

TABLE III Cognitive failure questionnaire overall scores

		Preoperative score	*Postoperative score*
GA group	Median (IQR)	26 ± 18	28 ± 22*
LA group	Median (IQR)	26 ± 18	25 ± 20

GA = general anesthesia; LA = local anesthesia; IQR = interquartile range. *Significant difference between pre and postoperative scores, $P < 0.05$.

TABLE IV Individual questionnaire items demonstrating significantly increased postoperative *vs* preoperative frequency of occurrence

GA group
- Do you find you forget whether you've turned off a light or a fire or locked the door? (6)**
- Do you fail to listen to people's names when you are meeting them? (7)*
- Do you find you forget which way to turn on a road you know well but rarely use? (12)**
- Do you fail to see what you want in the supermarket (although it's there)? (13)**
- Do you find you forget appointments? (16)*
- Do you find you accidentally throw away the thing you want and keep what you meant to throw away – e.g., throwing away a matchbox and putting the used match in your pocket? (18)*

LA group
- Do you find you forget whether you've turned off a light or a fire or locked the door? (6)**
- Do you find you forget appointments? (16)**

GA = general anesthesia; LA = local anesthesia. *$P < 0.05$, **$P < 0.01$. Wilcoxon signed rank test. Figures in parentheses refer to question numbers in the Appendix.

under GA were of longer duration than those performed under local (51 *vs* 25 min, $P < 0.01$).

Demographic data for those patients who failed to return full preoperative and postoperative questionnaire data are shown in Table II. These patients were excluded from the study. There were no significant differences between patients who did and did not return completed questionnaires in terms of gender, procedure length, ASA ratios or body mass index. In both GA and LA groups, the mean age was lower amongst those who did not return completed questionnaires. However, this difference only reached statistical significance in the LA group. Questionnaire results are shown in Table III.

There was no significant difference in preoperative CFQ score between the LA and GA groups (Mann-Whitney U). When preoperative and postoperative CFQ scores were compared, a small but significant increase was seen in the GA group ($P < 0.05$, Wilcoxon).

Preoperative and postoperative responses to individual questions were examined. Questions which generated significantly different preoperative and postoperative responses are shown in Table IV. Both LA and GA groups reported a significant increase in subjective cognitive failures in response to two items regarding memory lapses (questions 6 and 16). In the GA group, four other questions also demonstrated a significant increase in reported cognitive failures (Table IV). These questions related to lapses in attention (questions 7, 13 and 18) and memory (question 12).

Discussion

Our data suggest that there is a small but statistically significant increase in the number of cognitive failures experienced in the first three postoperative days by patients who underwent GA compared with those who did not. The increase in cognitive failures could be ascribed to just four of the 25 questions. However, the magnitude of the increase was not great (two CFQ points), and its clinical significance is doubtful. Two questions demonstrated an increase in reported lapses of memory in both LA and GA groups. It is likely that factors other than anesthetic technique have an impact on the subjective assessment of memory after surgery, e.g., changes in sleeping patterns or the use of opioid analgesia.

The use of the CFQ to detect cognitive changes in the postoperative period was originally described by Tzabar, Asbury and Millar in 1996.[10] Eighty-four patients were studied, undergoing day case surgery using a range of anesthetic techniques. An increase in cognitive failures of 3.4 points was noted after GA, but not LA. Although they were cautious attributing clinical significance to this result, it was put forward as evidence that the residual effects of anesthesia persist beyond 24 hr.

This study used identical methods but a much larger sample size. Our results suggest that deficits in cognitive function may be smaller than the original study concluded, and that such deficits may be of questionable clinical significance. It is not possible to conclude whether this apparent improvement is real (reflecting improvements in anesthetic technique) or simply a result of increased sample size.

Studies examining cognitive function after anesthesia in the 1980's and 90's appeared to show a significant impairment well into the first postoperative day.[3–5] Patients thus were advised to avoid driving or other potentially dangerous activities for 24 hr after surgery. The anesthetic drugs and techniques used in these studies are no longer used for ambulatory anesthesia. An example of this would be the use of diazepam for premedication, thiopentone for induction and halothane for maintenance.[4]

New anesthetic drugs with recovery profiles more suited to ambulatory surgery have emerged. The early recovery profiles (e.g., 0–4 hr) of modern anesthetics such as sevoflurane, desflurane and propofol have been well studied and recently reviewed.[1] Most psychometric tests appear to show a return to baseline values between four and six hours after anesthesia.[12–14] However, Canet *et al.* demonstrated residual cognitive impairment in 3.5% of elderly ambulatory subjects (median age 67.6) at seven days after GA.[15] It is difficult to conclusively attribute this impairment to GA, as there was no control group undergoing similar procedures under LA.

The advice currently given to patients regarding driving after ambulatory surgery does not appear to be evidence based. Sinclair *et al.* found no deficits in simulator driving skills at two, three or four hours postanesthesia in volunteers exposed to 30 min of desflurane.[16] Edward and Chung studied driving simulator performance of patients following anesthesia for knee arthroscopy.[17] Although both reaction time and electroencephalogram derived attention span were impaired at two hours, they had returned to baseline by 24 hr after anesthesia. Interestingly, despite impaired reaction time at two hours, patients maintained a more accurate road position at this stage of recovery than before their anesthetic. Further work is required before evidence based advice can be given to patients.

One of the limitations of this study is that it was not possible to randomize patients to receive either general or LA. The duration of procedures under GA was approximately twice as long as those performed under LA. It seems clear that the expected duration or complexity of the surgical procedure influenced the choice of anesthetic technique. This could be a potential source of bias. For example, if the GA group contained an excess of patients who had long procedures, they may have required more postoperative opioid analgesia than the LA group. This in turn could have lead to an excess of cognitive failures, which would be incorrectly ascribed to the anesthetic technique. Despite the probable bias against the GA group of longer procedure durations and likely increased postoperative opioid consumption, evidence for cognitive impairment was slight. This reinforces our conclusion that in every day clinical practice, delayed cognitive function after ambulatory anesthesia is minimal.

In conclusion, our subjective measure of cognitive function demonstrates a modest impairment after modern ambulatory anesthesia. Our results do not agree entirely with those of an earlier study using the same methods. Further work is required before the effects of modern anesthetic agents on delayed cognitive function can be fully quantified.

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