Original Article

Comparison of the genotoxicity of propofol and desflurane using the comet assay in the lymphocytes of patients who underwent lumbar discectomy

A randomized trial

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ABSTRACT

الأهداف: مقارنة التأثيرات السمية الجينية لعقار الديسفلوران والبروبوفول باستخدام مقايسة المذنب في المرضى الذين يخضعون لجراحة استئصال القرص الاختيارية.

المنهجية: أجريت هذه الدراسة العشوائية محكومة. اشتملت على المرضى الذين خضعوا لاستئصال القرص القطني الاختياري تحت التخدير العام مع عقار البروبوفول أو ديسفلوران. حصلنا على عينات الدم الوريدي في ٤ نقاط زمنية مختلفة: ٥ دقائق قبل تحريض التخدير (T1)، وبعد ساعتين من بدء التخدير (T2)، واليوم الأول بعد الجراحة (T3)، واليوم الخامس بعد الجراحة (T4). قمنا تقييم تلف حمض الديوكسي ريبونوكلييك في الخلايا الليمفاوية عن طريق فحص المذنب.

النتائج: اشتملت الدراسة على 30 مريضا، 15 في كل مجموعة في التحليل. كانت المجموعات متشابهة من حيث العمر والتوزيع بين الجنسين. لم تكن هناك فروق ذات دلالة إحصائية في التركيبة السكانية، ومدة الجراحة، وإجمالي استعمال الريميفنتانيل، وإجمالي استعمال بروميد الروكورونيوم. كشف اختبار المذنب أن طول الرأس، وكثافة الرأس، وكثافة الذيل، ولحظة الذيل عند T1 كانت متشابهة في مجموعتي عقار الديسفلوران والبروبوفول. كان قياس طول الرأس وطول الذيل ولحظة الذيل في مجموعة الديفلوران عند T4 أعلى بكثير مقارنة بمجموعة البروبوفول. كانت أطوال ذيل مجموعة الديفلوران في T1 وT2 وT3 أعلى بكثير من القيم المقابلة في مجموعة البروبوفول.

الخلاصة: عقار البروبوفول والديسفلوران لا يسببان تلف الحمض النووي في الخلايا الليمفاوية. ولكن، عند مقارنة البيانات الكمية، وجدنا أن البروبوفول لديه إمكانات سمية جينية أقل نسبيًا من الديسفلوران.

Objectives: To compare the genotoxic effects of desflurane and propofol using comet assay in patients undergoing elective discectomy surgery.

Methods: This was a randomized controlled study. Patients who underwent elective lumbar discectomy under general anesthesia with propofol or desflurane were included in the study. Venous blood samples were obtained at 4 different time points: 5 minutes before anesthesia induction (T1), 2 hours after the start of anesthesia (T2), the first day after surgery (T3), and the fifth day following surgery (T4). Deoxyribonucleic acid damage in lymphocytes was assessed via the comet assay.

Results: A total of 30 patients, 15 in each group, were included in the analysis. The groups were similar in terms of age and gender distribution. There were no significant differences in demographics, duration of surgery, total remifentanil consumption, and total rocuronium bromide consumption. The comet assay revealed that head length, head intensity, tail intensity, tail moment at T1 were similar in the desflurane and propofol groups. Head length, tail length and tail moment measured in the desflurane group at T4 were significantly higher compared to the propofol group. Tail lengths of the desflurane group at T1, T2 and T3 were significantly higher than the corresponding values in the propofol group.

Conclusion: Propofol and desflurane do not appear to induce DNA damage in lymphocytes. However, when the quantitative data were compared, it was determined that propofol had relatively lower genotoxic potential than desflurane.
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Keywords: genotoxicity, propofol, desflurane, comet assay, lymphocyte

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Every year, over 100 million people undergo surgery worldwide.[1] Although the safety of anesthesia has improved dramatically, toxicity-related concerns persist.[2] Thus, choosing the best anesthetic agent to minimize the risk of toxic effects is crucial. A continuing discussion exists concerning the health concerns and genotoxic consequences of anesthetics.[3]

It has been suggested that propofol has antioxidant properties due to its structural similarities with α-tocopherol and butylated hydroxytoluene, which are known to scavenge free oxygen radicals.[4] Although it is well established that reactive oxygen radicals can adversely affect cells or tissues, few studies have evaluated the genotoxic potential of propofol, and those that have carried out so have reported conflicting findings.[5-7] Some have reported the absence of genotoxic or mutagenic effects, while others have concluded that propofol may cause cellular toxicity.[2,8-11]

The genotoxic effects of volatile anesthetics remain a controversial issue.[12] Desflurane (1,2,2,2-tetrafluoroethyl difluoro methyl ether) is a third-generation inhaled anesthetic with a low blood/gas solubility coefficient, allowing rapid changes in anesthesia levels. Other features of this agent include a high vapor pressure, rapid action, and high minimum alveolar concentration (MAC) compared to other halogenated anesthetics (thus necessitating higher concentrations).[13] Although many studies have investigated the genotoxic effects of older halogenated anesthetics like isoflurane and sevoflurane, data are limited regarding the genotoxicity of desflurane.[1,14-18]

With recent developments in genetic analyses, it has become possible to detect the toxic effects of drugs at the genetic material level. A single-cell gel electrophoresis assay (comet assay) is a reliable method that is widely used to monitor deoxyribonucleic acid (DNA) damage.[19] The comet assay identifies DNA damage such as single-strand and double-strand breaks, alkali labile sites, oxidative lesions, and DNA repair. However, it does not identify mutagenesis effects.[2,20] In the majority of studies on the genotoxic effects of anesthetics, many factors that can cause DNA damage were ignored, such as major surgery, age factor, comorbidities, and the use of hypnotic agents, and measurements were not carried out with a comet assay.[12,15-18]

The aim of this research was to examine whether propofol possesses cytoprotective properties and induces genotoxicity to a lesser degree than desflurane. This was determined by measuring DNA damage and repair at specific time intervals subsequent to elective discectomy under anesthesia using the comet assay.

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Methods. This randomized controlled study was carried out at Sıtkı Kocman University Training and Research Hospital, Mugla, Turkey, between January 2022 and March 2022, after local ethics committee approval was received with respect to the Helsinki Declaration (no: 05/III). Patients enrollment was based on receipt of informed consent forms from all participants. The study adhered to CONSORT guidelines.

Only patients who underwent elective lumbar discectomy under general anesthesia, whose operation lasted at least 2 hours, were classified as Status I and II of the American Society of Anesthesiologists (ASA) physical system and were between 18-65 years of age were included in the study. The exclusion criteria were as follows: body mass index (BMI) of 30 and above, chronic systemic disease (diabetes mellitus, chronic pulmonary disorders, chronic kidney and liver disorders, and malignancy), having recently received radiation or chemotherapy, smokers and those with alcohol abuse, having received a blood transfusion during surgery, supplemental antioxidant consumers, who underwent general anesthesia within the previous 3 months, and known occupational exposures (namely, operating room staff members and chemical plant workers).

Microsoft Office 365 Excel, created by Microsoft in Redmond, Washington, USA, was used to generate a random allocation sequence. This sequence was employed to assign participants to 2 groups: the desflurane group (n=15) and the propofol group (n=15). A non-participating investigator unsealed the opaque envelopes that contained the information regarding group allocation. Consequently, participants and evaluators of patient outcomes were unaware of the patients' assigned groups.

The patients' gender information and age data on the day of surgery were recorded. Height and weight measurements were obtained on the day of surgery. The BMI was calculated as weight/height^2 (kg/m^2). Anesthesia information, blood collection times, and DNA damage measurements, which will be detailed below, were also recorded.

Upon the patients' arrival in the operating room, standard monitoring procedures were initiated, which included electrocardiogram, automatic noninvasive blood pressure measurement, peripheral oxygen saturation assessment, and bispectral index monitoring. No medications were administered during the initial

assessment. A total of 2 mg/kg of Propofol (Propofol-PF 1%, Polifarma, Turkey), 1 mg/kg of lidocaine (Aritmal 2%, Osel, Turkey), 2 mcgr/kg of remifentanil (Ultiva, Eczacibasi, Turkey), and 0.6 mg/kg of rocuronium bromide (Muscuron, Kocak Pharma, Turkey) were administered for induction. Patients were intubated with an appropriate endotracheal tube, and each patient was assigned into one of 2 anesthesia maintenance groups, desflurane (Suprane, Baxter, USA) or propofol, by opening a sealed envelope at this step of the process (given in a randomized manner). After intubation, all patients were mechanically ventilated utilizing the identical volume-controlled mode with an 8 ml/kg tidal volume, while the respiratory rate was modified to sustain an end tidal carbon dioxide (CO_2) pressure of 35-40 mmHg.

In the desflurane group, anesthesia was maintained using desflurane at 1% MAC with fractional inspired oxygen of 0.4 and an air mixture of 0.6, and to maintain a bispectral index of 40-60. Anesthesia was sustained in the propofol group through the continuous administration of propofol (6 mg/kg per hour) and titrations of intravenous remifentanil (0.5-1 mg/kg per minute). Fifteen minutes before the completion of surgery, all patients received 1 mg/kg of dexketoprofen trometamol and tramadol for postoperative pain management and 8 mg of ondansetron as an antiemetic (all intravenously). Neuromuscular blocking agents were reversed with 2 mg/kg of sugammadex.

Venous blood samples (5 ml) were obtained from every patient at the following time points: 5 minutes before anesthesia induction, when the venous access was achieved (T1), 2 hours after the initiation of anesthesia (T2), postoperative day one in the morning (T3), and postoperative day 5 in the morning, approximately 120 hours after anesthesia induction (T4). Blood samples were collected in sodium heparin tubes. All samples were coded by the anesthesiologists so that the biochemists were blinded to the groups and time points. Blood samples were tested as soon as they were received, with procedures carried out in ideal environmental circumstances to prevent bias and batch effects.

The DNA damage caused by desflurane and propofol was assessed using the comet assay IV, version 4.3.2 for Basler FireWire. Lymphocytes were isolated using histopaque and leucosep centrifuge tubes, and the cell media were discarded. The technique was iterated 3 times for each group. The cells were washed 3 times in 0.1 M phosphate buffered saline (PBS), separated, and suspended in 0.1 M PBS with low melting agarose (LMA) at a concentration of 2×10^3 cells in 75 µL. The cells were segmented into 3 levels. The initial layer consisted of 1% standard melting agarose. The cells were placed in a second layer, and 1% LMA was added to the solid first layer. A third layer with 1% LMA was added in the same manner. Processing was carried out in a refrigerated room. Following solidification, slides were incubated in a lysis solution at 4°C for one hour. The slides were immersed in the electrophoresis buffer for 20 minutes at 4°C, followed by electrophoretic separation at 25 V (300 mA, approximately 0.74 V/cm) for 30 minutes at 4°C. The slides were washed 3 times with the neutralizing buffer for 5 minutes each, then submerged in methanol at -20°C for 5 minutes. To avoid external DNA damage, the procedures were carried out in a light-free environment. The slides were dried and then soaked in 60 µL of ethidium bromide. Fluorescent microscopy was carried out using 510-560 nm excitation and 590 nm emission filters from Nikon. Photos of 50 comets were taken on each duplicate slide, using a ×20 magnification.

The comet responses were scored for head length, tail length, head intensity, tail intensity, and tail moment of DNA. Each of these parameters was calculated for the time points of sampling (T1, T2, T3, and T4). Measurements during these time periods were compared between the desflurane and propofol groups and also within each group. Changes (amount of change) between T4 and T1 were also calculated, and between- and within-group comparisons were carried out.

Statistical analysis. The sample size was calculated based on data from a pilot study that involved 5 patients in each group using the Power and Sample Size Program (P.S version 3.1.2). For a 2-sided type 1 (α) error of 0.05 and a power (1-β) of 0.90, we determined that including 15 patients per group was necessary to identify a significant difference of 1.25 µm in tail intensity. Every statistical analysis was carried out utilizing the Statistical Package for the Social Sciences, version 25.0 for Windows (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Shapiro-Wilk test. Data are presented as mean ± standard deviation (SD) for normally distributed continuous variables, median (25th-75th percentile) for non-normally distributed continuous variables, and as count (percentage) for categorical variables. Between-group comparisons of continuous variables were carried out using either the Student's t-test or Mann-Whitney U test, depending on the normality of the distribution. The analysis of categorical variables between groups was carried out using Chi-square tests. For normally distributed repeated measurements, a 2-way repeated measures analysis of variance (ANOVA) was utilized.

Non-normally distributed repeated measurements were analyzed using Friedman's analysis of variance by ranks. Statistically significant results were defined as *p*-values less than 0.05.

Results. A total of 35 patients were assessed for eligibility, 2 of whom declined to participate. After randomization, one patient from the desflurane group and one patient from the propofol group received a blood transfusion, and one patient from the desflurane group was excluded from the analysis because surgery was completed in 1.5 hours. The remaining 30 patients, 15 in each group, were included in the analysis (Figure 1).

In both groups, 53.33% of the participants were male (p=1.000). The mean age in the desflurane group was 50.80±6.75 years, while in the propofol group it was 49.60±9.46, with no significant age difference between the groups (p=0.692). There were no significant variations in weight (p=0.555), height (p=0.241), BMI (p=0.900), duration of surgery (p=0.319), total remifentanil consumption (p=0.777), or total rocuronium bromide consumption (p=0.798) between the groups. Inevitably, total propofol consumption was significantly higher in the propofol group (p<0.001; Table 1).

There were no significant differences in mean head length, head intensity, tail intensity, and tail moment at T1 between the desflurane group and the propofol group. However, at T4, the desflurane group exhibited significantly higher mean head length (p=0.033), mean tail length (p=0.037), and median tail moment (p=0.036) than the propofol group. Tail lengths in the desflurane group were also significantly greater than in the propofol group at T1 (p=0.028), T2 (p=0.007), and T3 (p=0.049). No significant differences were observed in other comparisons carried out both between and within the groups (Table 2).

Discussion. In this study, we compared the genotoxic effects of propofol and desflurane, which

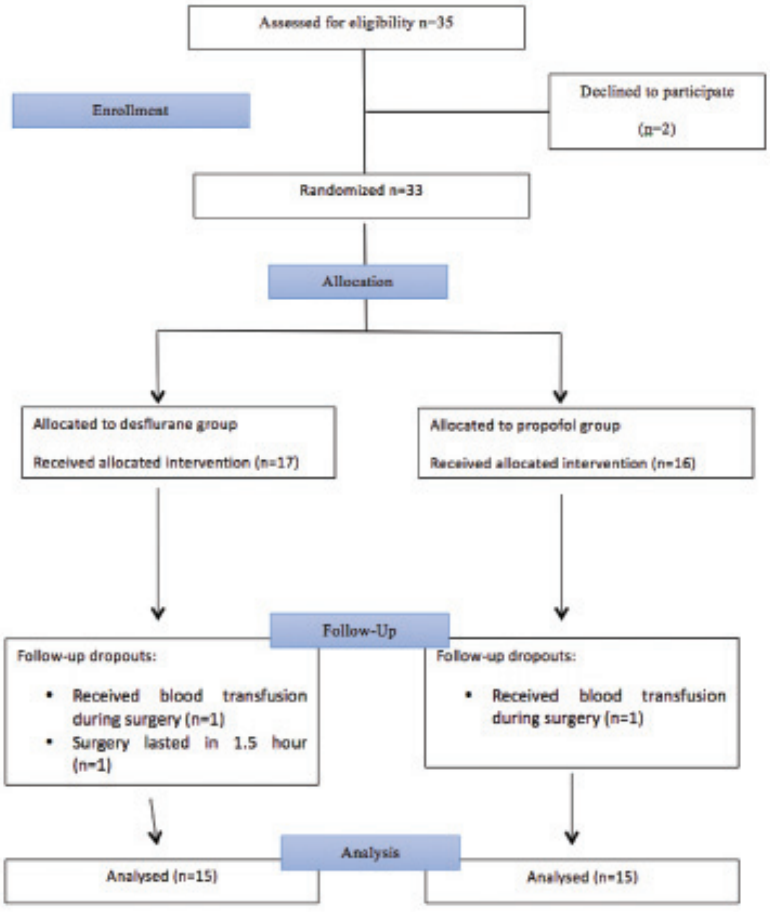

Figure 1 - Flowchart of the study.

Table 1 - Summary of demographics, operation characteristics, and measurements with regard to groups.

Variables	Desflurane (n=15)	Propofol (n=15)	*P*-values (between groups)
Gender			
Male	8 (53.3)	8 (53.3)	1.000
Female	7 (46.7)	7 (46.7)	
Age (years)	50.80±6.75	49.60±9.46	0.692
Weight (kg)	71.20±7.32	69.60±7.36	0.555
Height (cm)	169.93±5.43	167.60±5.23	0.241
Body mass index (kg/m^2)	24.64±2.15	24.74±1.80	0.900
Duration of surgery (minutes)	145.67±13.61	151.00±15.14	0.319
Total remifentanil consumption (µgr)	1038.33±151.17	1055.87±183.69	0.777
Total rocuronium bromide consumption (mg)	47.63±4.72	47.13±5.81	0.798
Total propofol consumption (mg)	170 (150-200)	1260 (990-1390)	<0.001

Values are presented as numbers and precentages (%) for categorical variables or mean ± standard deviation (SD) for normally distributed continuous variables or median (25th percentile - 75th percentile) for non-normally distributed continuous variables.

were determined by carrying out a comet assay analysis of lymphocytes of ASA I and II patients who underwent lumbar discectomy surgery. The results of the study revealed that propofol exhibited significantly less genotoxic potential than desflurane, although there were no significant differences between any genotoxic measurements at baseline or at any time period after the administration of either agent.

Although there are studies to the contrary, the majority of available data indicate that exposure to anesthetics, particularly nitrous oxide and some volatile halogenated agents, is associated with genotoxic, mutagenic, and other risks.[1,21,22] However, information regarding the genotoxic effects of propofol and desflurane, which are used in modern anesthesia practice, remains unclear.[15,23-25] The results of the present study showed that head length and tail moment values 5 days after (T4) the administration of propofol anesthesia were significantly lower compared to the administration of desflurane. Although the tail lengths at T2, T3, and T4 were significantly lower with propofol anesthesia compared to desflurane, the fact that the tail length before anesthesia was already significantly lower in the propofol group precludes conclusive comments. Tas et al[26] carried out a comparison of the protective effects of desflurane and propofol anesthesia in rats using a hepatic ischemia-reperfusion injury model. The authors reported that, after 30 minutes of hepatic ischemia, malondialdehide (lipid peroxidation product) levels in intra cardiac blood and liver tissue samples and the degree of tissue ischemia were similar in both groups. However, some research has attempted to compare the genotoxic effects of these 2 substances with those of other anesthetics. Using a model of tourniquet-induced lower extremity ischemia, the effects of sevoflurane and propofol on DNA damage were evaluated in an experimental study involving rabbits.[14] The results demonstrated that sevoflurane exhibited superior control over lipid peroxidation compared to propofol. Notably, propofol appeared to require doses higher than the clinical norm to effectively mitigate lipid peroxidation. However, it was observed that in the later stages of reperfusion, there was no discernible difference between the 2 anesthetic agents in terms of their ability to mitigate oxidative stress and genotoxicity. In a study similar to ours, DNA damage in lymphocytes measured using a comet assay during and after the use of isoflurane, sevoflurane, and propofol in minimally invasive otorhinolaryngological surgeries was investigated.[1] There was no discernible increase in DNA damage during or after anesthesia with any of these agents. In a study from Turkey involving pediatric patients undergoing surgery lasting at least 2 hours (under desflurane or sevoflurane), there were no significant inter- or intragroup changes in lymphocyte DNA damage measured by a comet assay compared to baseline values in blood samples taken at 60 minutes, 120 minutes, 24 hours, and on the fifth day after the onset of anesthesia.[22] Our study yielded results in favor of propofol, similar to the majority of previous research. Nonetheless, comprehensive studies are needed to investigate the genotoxic effects of these 2 agents, preferably including other agents for which genotoxic effects have been clarified.

As previously stated, the phenolic structure of propofol bears resemblance to that of α-tocopherol, indicating the presence of antioxidant properties that may inhibit genotoxicity and cytotoxicity in

Table 2 - Summary of measurements regarding DNA damage with regard to groups.

Parameters	Group DES (n=15)	Group PRO (n=15)	*P*-values (between groups)
Head length (µm)			
T1	22.15±3.84	21.36±2.14	0.494
T2	22.52±4.59	21.75±3.09	0.598
T3	24.16±3.29	23.17±3.42	0.429
T4	23.71±2.88	21.54±2.40	0.033
P-values (repeated measurements)	0.216	0.211	
Change*	1.56±4.91	0.18±1.87	0.321
Tail length (µm)			
T1	21.69±1.95	19.63±2.83	0.028
T2	22.92±3.19	18.14±5.50	0.007
T3	21.33±3.42	18.45±4.23	0.049
T4	22.68±3.11	19.48±4.74	0.037
P-values (repeated measurements)	0.219	0.519	
Change*	0.99±3.92	-0.16±3.76	0.421
Head intensity (%)			
T1	80.14±10.07	74.82±12.92	0.218
T2	75.84±9.01	68.96±18.90	0.214
T3	78.17±7.04	76.17±13.49	0.615
T4	78.06±.48	77.01±13.05	0.789
P-values (repeated measurements)	0.740	0.187	
Change*	-2.08±10.63	2.19±16.90	0.414
Tail intensity (%)			
T1	23.13±16.43	23.34±4.66	0.964
T2	23.51±10.09	19.98±3.24	0.208
T3	22.07±6.88	19.19±4.64	0.190
T4	21.74±7.46	23.17±2.72	0.492
P-values (repeated measurements)	0.882	0.353	
Change*	-1.39±14.59	-0.17±4.92	0.762
Tail moment			
T1	5.80 (3.74-7.84)	3.34 (2.37-8.22)	0.152
T2	3.09 (2.49-5.93)	3.38 (2.31-4.65)	0.520
T3	4.85 (1.93-6.43)	3.69 (2.40-6.41)	0.917
T4	5.81 (3.62-6.49)	3.01 (2.02-4.49)	0.036
P-values (repeated measurements)	0.178	0.564	
Change*	-0.18 (-1.06 - 1.42)	-0.74 (-3.99 - 0.64)	0.254

Values are presented as the mean ± standard deviation (SD) for normally distributed continuous variables or median (25th percentile - 75th percentile) for non-normally distributed continuous variables. *Difference between T4 and T1, negative values represent decrease and positive values represent increase. DES: desflurane, PRO: propofol, T1: 5 minutes before anesthesia induction, T2: 2 hours after the initiation of anesthesia, T3: postoperative first day in the morning, T4: postoperative fifth day after anesthesia induction

lymphocytes.[8] Almost all human studies have claimed that propofol has no genotoxic and mutagenic effects and have even reported protective effects. A lack of mutagenicity of propofol and its metabolites has also been demonstrated in bacteria, fungi, and mammalian cells.[24,27] Our results do not conflict with prior reports, as DNA damage measures were similar before and after propofol administration. Braz et al[2] showed that propofol did not cause DNA damage in white blood cells and did not change the level of malondialdehyde in the plasma of patients. The aforementioned authors demonstrated in an additional investigation that patients undergoing noninvasive surgery under propofol anesthesia exhibited diminished apoptosis of T helper lymphocytes and decreased levels of oxidized purines.[8] In fact, DNA damage did not increase in the patients' lymphocytes at 120 minutes or 24 hours post-induction. Furthermore, propofol did not directly affect the expression of DNA repair genes the human 8-oxoguanine DNA N-glycosylase 1 (hOGG1) and X Genotoxicity of propofol and desflurane. Korkmaz Toker et al[28]-ray repair cross-complementing protein 1 (XRCC1). Various studies have reported that propofol and its metabolites do not increase chromosomal abnormalities in lymphocytes and do not trigger sister chromatid exchange (indicative of increased mutagenicity) in hamster ovary cells and

lymphocytes.[9,24,28] However, some undesirable adverse effects of propofol have been reported in animal studies. Honegger et al[10] showed that propofol caused irreversible changes in gamma-aminobutyric acid (GABA) ergic neuron structures in brain cell culture. In another study, it was reported that propofol reduced the fertilization rate of rat oocytes.[23] Interestingly, high concentrations of propofol administration to Henrietta Lacks (HeLa) cells was shown to induce copy number depletion in mitochondrial DNA, regardless of exposure time.[11] Given these studies, the potential for genetic damage must be evaluated to ensure the safety of propofol by investigating different propofol dosages in different cells.

The genotoxic effects of desflurane, being a volatile anesthetic of the new generation, remain insufficiently investigated. In the current study, we observed no substantial disparity in genotoxic measurements before and after the administration of desflurane. A previous review that gathered comprehensive results for various agents indicated that desflurane did not exhibit any substantial effects on bacterial mutation based on in vitro and in vivo cytogenetic assessments.[25] Nonetheless, later studies highlighted the genotoxic or mutagenic effects of desflurane. For example, Akin et al[15] demonstrated an increase in sister chromatid exchange in lymphocytes during desflurane administration and in the days following surgery, as compared to preoperative levels. In another investigation, elevated sister chromatid exchange per cell was observed 3 hours after anesthesia in patients who received 1 MAC of desflurane during major surgeries, whereas no sister chromatid exchange effect was observed in patients receiving desflurane below 0.5 MAC.[17] In a recent study, a genotoxic effect was reported after minor surgeries under anesthetic maintenance with desflurane.[29] Nogueira et al[12] evaluated baseline and post-operative 24-hour lymphocyte samples obtained from desflurane recipients and found significant increases in DNA damage at 24 hours. In vitro results of comet assays have shown that desflurane causes DNA damage in lymphocytes.[16,18] However, in one of these studies, no genotoxic effects were observed on sperm cells.[18] It has been suggested that the cellular toxicity impact of desflurane may be associated with the need for a high dosage (as a result of high MAC values) or due to elevated oxidative stress due to the release of inflammatory cytokines.[29] However, current data are insufficient to make definitive comments regarding the genotoxic effects of desflurane. In fact, in the present study, there was no significant change in any parameters after desflurane administration.

Study's strength & limitations. A strength of our study is the exclusion of patients with additional risk factors for cellular injury, including comorbidities, advanced age, medications, poor physical condition, obesity, smoking, and alcohol abuse. Crucially, all subjects enrolled in the study had undergone the same surgical procedure, limiting the impact of potential biases in this respect. Finally, the genotoxic effects of anesthetics were investigated at 3 different time points, the longest of which was the fifth day after anesthesia. However, our study also had some limitations. The first blood sample after anesthesia was taken after an interval of 2 hours, and therefore cellular damage that could be caused by the stress of intubation at the beginning of surgery was not analyzed. Additionally, we only included patients classified as ASA I or ASA II. Desflurane and propofol are both agents with controversial genotoxic effects. Comparing the genotoxic effects of these 2 agents to those of agents such as isoflurane, sevoflurane, and halothane, whose genotoxic effects are better documented, therefore requires additional comprehensive research. Finally, due to the study design, the relationship between the agents and genotoxicity was not assessed with respect to dosage.

In conclusion, based on the findings of this study, propofol and desflurane did not induce DNA damage in the lymphocytes of patients who underwent elective discectomy surgery (ASA I and ASA II). When quantitative data were compared, propofol appeared to have lower genotoxic potential than desflurane. More studies are needed to ascertain the individual genotoxic effects of these 2 agents and to compare their genotoxic effects with those of other anesthetic agents.

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