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Effects of Isoflurane and Propofol on Hepatic and Renal Functions and Coagulation Profile After Right Hepatectomy in Living Donors

U. Ozgul, M. Ucar, M.A. Erdogan, M.S. Aydogan, H.I. Toprak, C. Colak, M. Durmus, and M.O. Ersoy

ABSTRACT

We compared postoperative hepatic and renal functions and coagulation profiles in living donors undergoing right hepatectomy under isoflurane (n = 40) versus propofol (n = 40) anesthesia. After induction, anesthesia was maintained with isoflurane/air-O_2 (group I) or propofol/air-O_2 (group P) in addition to remifentanil and atracurium infusion in both groups. Aspartate aminotransferase, alanine aminotransferase, international normalized ratio (INR), activated partial thromboplastin time (aPTT), albumin, total bilirubin, blood urea nitrogen, creatinine, estimated glomerular filtration rate (GFR), platelet count, and hemoglobin levels were measured in the preoperative period, after end of the operation, and on the first, third, fifth and seventh postoperative days (PODs). INR was significantly increased on POD 3 and aPTT on POD 5 in group I compared with group P ($P < .05$). Albumin level was significantly lower in Group I on POD 1 and 3 ($P < .05$). GFR was significantly lower on POD 1 in the group I compared with group P ($P < .05$). The postoperative coagulation, GFR, and albumin values were superior following administration of propofol than isoflurane in donors who underwent living hepatectomy; however, both approaches were clinically safe, with no significant clinical difference.

Liver transplantation is often the only treatment option for patients with end-stage liver disease. As a result of limited cadaveric organ donation and the increased number of patients in need of transplantation, there has recently been an increased number of procedures using living donor cases.[1,2] Although donor hepatectomies are generally performed without complication, donor safety is of upmost importance. The complications include hemorrhage, vascular or biliary problems, coagulation disorders, ileus, pleural effusion, arrhythmia, ulcer bleeding, hepatic insufficiency, and/or death. Major hepatic resection can affect liver and renal organ functions as well as cause postoperative coagulopathy.[3,4]

Table 1. Demographic Data

	Group I (n = 40)	Group P (n = 40)
Age (y)	33 (18–61)	31 (19–48)
Gender (M/F)	22/18	21/19
Height (cm)	170 (152–185)	167.5 (150–185)
Body weight (kg)	70 (46–92)	68.5 (50–90)
BMI (kg/m^2)	23.61 (18.66–34.08)	23.66 (18.4–33.3)

Abbreviations: *BMI, body mass index; group P, propofol group; group I, isoflurane group.*

Values are presented as median (range) or numbers of donors.

The choice of anesthesia has not yet been established for donor hepatectomy operations. In addition to inhaled agents, such as isoflurane, desflurane, and sevoflurane, one may use intravenous (IV) agents, such as propofol.[5–7] The objective of the present study was to evaluate the effects of propofol and isoflurane anesthesia on liver and kidney functions as well as the coagulation profile of donors following hepatectomy.

METHODS

Ethical approval was obtained from our Institutional Review Board. All living donors provided written informed consents. A total of 80 donors aged 18–65 years of American Society of Anesthesiologists physical status I were included for right hepatectomy in the present study. Patients were excluded if they had a

From Department of Anesthesiology and Reanimation (U.O., M.A.E., M.S.A., H.I.T., M.D., M.O.E.) and Department of Biostatistics and Medical Informatics (C.C.), Faculty of Medicine, Inonu University, Malatya, Turkey; and Department of Anesthesiology and Reanimation, Adıyaman State Hospital (M.U.), Adıyaman, Turkey.

Address reprint requests to Ulku Ozgul, MD, Department of Anesthesiology and Reanimation, School of Medicine, Inonu University, Malatya, Turkey. E-mail: ulku.ozgul@inonu.edu.tr

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Table 2. Intraoperative Data of Donors

	Group I	Group P
TLV (mL)	1,179.5 (879–1,520)	1,150 (867–1,600)
GV (mL)	759 (515–1,060)	789 (497–1,190)
RLV ratio (%)	33.6 (29–42.2)	34.1 (28.9–41.4)
Surgical time (min)	360 (222–590)	385 (240–540)
Anesthetic time (min)	372.5 (235–600)	395 (250–555)
BIS values	48 (38–55)	46 (35–58)
Administered crsytalloid volume (mL)	4,150 (2,400–8,000)	5,000 (2,000–9,000)
Administered colloid volume (mL)	500 (0–1000)	500 (0–1500)
Estimated blood loss (mL)	400 (200–750)	400 (150–900)
Urine output (mL)	1,240 (400–2,650)	1,305 (235–5,910)
Postoperative hospital stay (d)	5 (3–7)	5 (4–7)

Abbreviations: *TLV, total liver volume; GV, graft volume; RLV ratio, remnant liver volume ratio; group P, propofol group; group I, isoflurane group; BIS, bispectral index.*
Values are expressed as median (range).

history of an allergy to propofol or isoflurane, were prescribed β-adrenergic or Ca^{2+} channel blockers, were receiving heparin or inotropic agents, or were using a nonsteroidal antiinflammatory medication.

During surgery, standard anesthetic monitoring was performed, including blood pressure (noninvasive), electrocardiography, peripheral oxygen saturation (pulse oximetry), and bispectral index (BIS; model A-2000 TM; Aspect Medical System, Newton, Mass, USA). Peripheral venous access was obtained with the use of a 20-G IV catheter in the dorsal surface of the hand delivering isolyte-S infusion. The patients were randomly divided into 2 groups (propofol or isoflurane) with the use of a computer-generated random number table. Patients received 100% oxygen for 3 minutes before initiation of anesthesia. Anesthesia was induced in both groups with 2 mg/kg propofol (1% propofol; Fresenius) and 1 μg/kg remifentanil with 0.6 mg/kg atracurium. Anesthesia administration was continued in the propofol group (group P; n = 40) with 10 mg/kg/h in the first 10 minutes, 8 mg/kg/h in the following 10 minutes, and 6 mg/kg/h thereafter, to ensure that the bispectral index (BIS) value was maintained between 40 and 60. In the isoflurane group (group I; n = 40), anesthesia administration was continued to ensure an isoflurane concentration of 0.5%–1.5% that the BIS value remained between 40 and 60. Ventilation was controlled with a tidal volume of 7–10 mL/kg and ventilator rate adjusted to maintain an end-tidal CO_2 of 35–40 mm Hg. Concentrations of isoflurane were measured with the use of an anesthesia device (Dräger Primus, Germany). A constant fresh gas flow of 3 L/min (60% air and 40% oxygen) was used during the maintenance of anesthesia. Both groups received remifentanil (0.25 μg/kg/min) and atracurium (0.5 mg/kg/h) infusions (Life Care 5000 Infusion System; Abbott, Sligo, Ireland).

A radial arterial cannula was inserted into the patient's nondominant hand. Central venous pressure (CVP) was monitored from the internal jugular vein via a central catheter. In addition, we inserted nasogastric tube and a nasopharyngeal heat probe. Neuromuscular conduction was monitored via a train-of-four device. Intraoperative blood pressure and heart rate were targeted to $\pm$20% of preoperative values in both groups. Bradycardia, defined as a heart rate <45 beats/min, was treated with 0.5 mg IV atropine. When mean arterial pressure decreased to <60 mm Hg, we administered IV crystalloid and increasing doses of 5 mg IV ephedrine. The same surgical team performed all operations using the Pringle maneuver routinely. All donors were extubated at the end of the operation and subsequently transferred to the intensive care unit. Total liver volume (TLV), graft volume (GV), remnant liver volume (RLV) ratio, surgical and anesthetic times, total administered fluids, estimated blood loss, urine output, duration of postoperative hospital stay, aspartate aminotransferase (AST) level, alanine aminotransferase (ALT) level, total bilirubin (TB) level, international normalized ratio (INR), activated partial thromboplastin time (aPTT), albumin level, blood urea nitrogen (BUN) value, creatinine (Cr) level, estimated glomerular filtration rate (GFR; calculated with the Modification of Diet in Renal Disease [MDRD] study equation),[8] platelet count (Plt), hemoglobin (Hb), and hematocrit (HTC) concentration were analyzed in the perioperative period, at the end of the operation, and on postoperative days (PODs) 1, 3, 5, and 7.

Continuous variables are given as median values (range), categoric variables as number and percentage. The assumption of a normal distribution was tested with the use of the Shapiro-Wilk test. Comparisons of 2 groups that did not show a normal distribution was performed with the Mann-Whitney *U* test. The difference between the 2 test groups regarding sex was performed with the Yates-corrected chi-square test. Data were accepted to be statistically significant if $P < .05$.

RESULTS

The demographic data of the patients in the 2 groups were similar (Table 1). Surgical and anesthetic times, TLV, GV, and RLV were similar between the 2 groups (Table 2). Intraoperative hemodynamic variables, including mean arterial pressures, HR, and CVP, were also similar in both groups (Table 3).

Hb, HTC, and Plt values were similar between the 2 groups (Table 4). GFR was lower on POD 1 in group I compared with group P ($P < .05$; Table 5). INR was significantly higher on POD 3 and aPTT on POD 5 in group I compared with group P ($P < .05$). The albumin level was

Table 3. Intraoperative Hemodynamic Variables

	Dissection		Resection		End of the Operation	
	Group I	Group P	Group I	Group P	Group I	Group P
HR (beats/min)	74.5 (54–103)	73 (52–110)	86.5 (60–108)	85 (61–106)	94 (61–112)	87.5 (60–107)
MAP (mm Hg)	81 (59–124)	77 (53–105)	74.5 (58–109)	78.5 (61–111)	87.5 (58–120)	91 (65–128)
CVP (mm Hg)	9 (6–12)	9 (6–13)	6.5 (5–9)	7 (5–9)	6.5 (5–9)	6 (5–9)

Abbreviations: *HR, heart rate; MAP, mean arterial pressure; CVP, central venous pressure; group P, propofol group; group I, isoflurane group.*
Values are expressed as median (range).